OCTOBER 2, 1961

missiles and rockets

THE MISSILE/SPACE WEEKLY

THE UNIVERSITY OF MICHIGAN
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ENGINEERING LIBRARY

Republic's Long-Life Plasma Space Engine

DOD + NASA: $55.5 Billion in FY '63? . .

Apollo Boss Promised Needed Authority

'Draco' May Help Fill Pre-Saturn Gap . .

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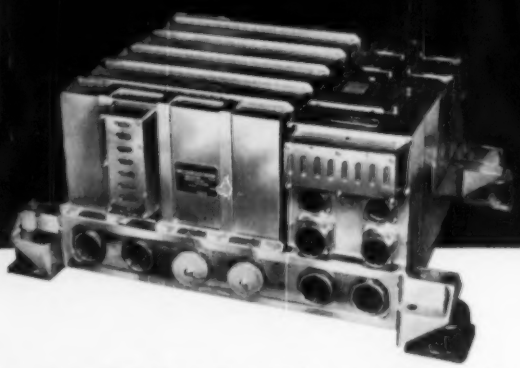

GUIDANCE COMPUTER
for NASA'S CENTAUR

Sometime this year, CENTAUR will be spaceborne. Already, the projected uses of CENTAUR bear fascinating implications for the future . . . placing a satellite in an orbit so exacting that it will remain in one spot over the earth's surface . . . soft landings on lunar and planetary bodies . . . timed launchings of several satellites from a single vehicle. Several major guidance functions will be performed in CENTAUR by a compact digital computer system from Librascope. It weighs 62 pounds, occupies little more than ¾ cubic foot. A note to Librascope outlining your control problems will bring a prompt answer from the country's most versatile manufacturer of computer control systems.

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GARRETT-U.S. AIR FORCE 'SPUR'

..one answer to America's future power needs in space

The joint U.S. Air Force-AEC Project SPUR is a research and development program being conducted by an industry team of Garrett, Aerojet-General Nucleonics (reactor) and Westinghouse, Lima (generator) to provide a power source to produce 300-1000KW electrical power in space for one year or more. Power is obtained by conversion of nuclear fission energy to mechanical (shaft) power with a potassium vapor turbine. Equipment includes: reactor, primary and secondary loop pumps, boiler, turbo-generator and condenser-radiator.

Long lead time is essential to the development of large nuclear space power systems. Present methods of power generation would require an impractical heat rejection surface nearly the size of a football field for a power output of one megawatt—power which will be needed for critical space missions already in the planning stage.

Garrett's AiResearch Divisions have now completed the initial SPUR design studies and proved the project's feasibility to supply continuous accessory power and low thrust electrical propulsion in space for long periods of time.

Cutting projected 1 MW power systems to 1/10th the size and 1/5th the weight of present power systems under development will be possible because of SPUR's capability to operate at higher temperatures, thereby sharply reducing the required radiator area.

Garrett has been working with the Air Force and the Atomic Energy Commission on SPUR as the prime contractor for more than one year and has more than five years of experience in space nuclear power development. Also an industry leader in high speed rotating machinery, heat transfer equipment, metallurgy and accessory power systems, the company is developing design solutions for SPUR in these critical component system areas.

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FLYING MISSILE LAUNCHER. New Boeing B-52H missile bomber can take off faster, fly farther and strike harder than any previous B-52. It's shown here carrying models of four hypersonic Skybolt air-launched ballistic missiles, a 1000-mile range weapon now under development. The Strategic Air Command B-52, most versatile long-range weapon system in the U. S. Air Force arsenal, can also carry supersonic Hound Dog missiles for inflight launching, in addition to its regular bomb-bay load of gravity bombs.

Capability has many faces at Boeing

THREE-ENGINE JET. Scale model of America's first short-range jetliner, the Boeing 727. Already, 117 Boeing 727s have been ordered by American, Eastern, Lufthansa and United airlines for delivery beginning in 1963.

MINUTEMAN, first U. S. Air Force solid-fuel intercontinental ballistic missile, scheduled to be operational in 1962, will be stored ready for quick launching in underground silos. Boeing is weapon system integrator for Minuteman.

MARS DEPARTURE. Artist's concept of 8-man space vehicle taking off from Mars for return to earth. This space transport system, based on a Boeing study, would enable explorer scientists to spend months on Mars with instruments and life-support equipment. Boeing scientists are at work on many phases of space flight.

BOEING

THE MISSILE / SPACE WEEKLY

missiles and rockets

Volume 9, Number 14 October 2, 1961

THE COVER

Republic technician inspects XE-1A plasma pinch space engine, which company says will be test flown early next year. It is reported to run indefinitely. See p. 40.

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Published each Monday with the exception of the last Monday in December by American Aviation Publications, Inc., 1001 Vermont Ave., N.W., Washington 5, D.C. Cable Address: AMERAV.

Printed at Judd & Detweiler, Inc., Washington, D.C. Second class postage paid at Washington, D.C. Copyright 1961, American Aviation Publications, Inc.

Subscription rate: U.S. and Possessions, Canada, and Pan American Postal Union Nations: 1 year $5.00, 2 years $8.00, 3 years $10.00. All other foreign: 1 year $15.00, 2 years $25.00, 3 years $35.00. Single copy prices: regular issues 50 cents each; special issues $1.00 each. Subscriptions are solicited only from persons with identifiable commercial or professional interests in the missile/space industry. Subscription orders and changes of address should be referred to Circulation Fulfillment Mgr. Missiles and Rockets, 1001 Vermont Ave., N.W., Washington 5, D.C. Please allow 4 weeks for change to become effective and enclose recent address label if possible.

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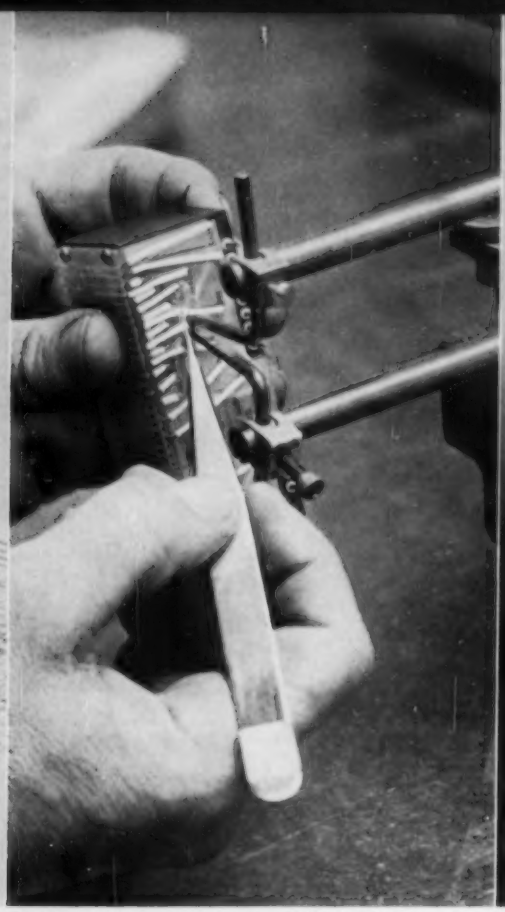

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Raytheon "Know-How" Supports M.I.T.'s Advanced Polaris Development

Raytheon is presently devoting part of its unique industrial support talents and facilities to system design engineering and manufacture of electronics for the Advanced Polaris Guidance System. For this program Raytheon is under technical direction of Massachusetts Institute of Technology's Instrumentation Laboratory.

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letters

Apollo Guidance, Cont.

To the Editor:

I heartily concur with your opinion that "guidance for a program of the *Apollo* type must be developed early" (editor's comment on letter headed "Apollo Guidance," M/R, Sept. 11, p. 6). The hazarding of valiant Americans on a mission of this order is not to be undertaken lightly, even in the present charged international climate. The prospects that this program portends for the military capabilities upon which civilization itself may depend only serve to emphasize the cogency of your comment.

When one considers the pressing time scales currently being discussed for the *Apollo* program, and the stringent accuracy and reliability requirements inherent in its manned mission, it is readily apparent that the time necessary to develop *new* components and systems to the required levels just is not available. This means that the *Apollo system must* be based on current program performances.

A more dramatic way of visualizing the problem is to complement the reliability figures to yield the probability of failure and then estimate the number of satisfactory flight tests necessary to reduce this probability to the levels dictated by the national interest and crew survival. For unmanned systems a high probability of failure can be overcome by increased deployment, i.e., by dollars, whereas for a manned mission no such simple solution is available. Even with astronauts of the calibre of Shepard and Grissom, willing to take the risks, the national interest cannot tolerate another *Vanguard* fiasco.

It was therefore with nothing less than shock and dismay that I read of NASA intentions to contract directly for the development of guidance and control for *Apollo* without even a most cursory review of current systems performances. The inexplicability of this action is only compounded by the companion decisions to designate a different contractor for production and to delay selection of this second team-member until the development is completed. . . .

If the design study by MIT reported in your issue of Aug. 14 (p. 37) is supposed to constitute a review of current capabilities, just how comprehensive was it? The acknowledged objectivity noted in your TECHNICAL COUNTDOWN of Sept. 4 (p. 21) hardly bodes an unbiased evaluation of all factors. Was the possibility of combining proven elements (gyros, accelerometers and computers) of several current systems to yield a near-optimum *Apollo* system even considered? To what extent were the reliability, performance and schedule penalties of the proposed hydra-headed program prosecution assessed?

Without attempting to cloud the brilliant escutcheon of Dr. Draper, one can readily state that the very diversity of current systems applications and industry capabilities forbids the letting of such a critical contract without the most thoroughgoing review of existing programs. One is driven to conclude either that NASA lacks the in-house capacity to conduct such a review or that current performance results are so enmeshed in security measures that they are effectively lost within the Administration. . . .

Immediate and vigorous Administration and/or Congressional action to correct this circumstance is urgently needed. Responsibility for the planning and direction of *Apollo* should of itself endow NASA with all the requisite security qualification and "need to know" for current performance information.

The following telegram on this subject was sent to Senator Jacob K. Javits (R-N.Y.) when public announcement of the proposed contract was first made on Aug. 10:

HON. JACOB JAVITS
URGENTLY REQUEST YOU INVESTIGATE NASA CONTRACT MASS INSTITUTE TECHNOLOGY FOR APOLLO GUIDANCE. PROTEST DENIAL OF COMPETITIVE BIDDING THIS CRITICAL TASK. SUGGEST NO CONTRACT WITHOUT COMPLETE REVIEW ALL CURRENT INERTIAL GUIDANCE SYSTEMS FOR PROVEN ACCURACY AND RELIABILITY. REVIEW MUST INCLUDE SYSTEMS NOT BASED ON MIT DESIGNS. YOUR COMMENTS DESIRED.

Subsequent correspondence from Senator Javits included a copy of a NASA letter acknowledging his inquiry and promising comment on the above telegram. To date (Sept. 14) no such comment has been received.

Although I am presently employed in evaluation activities for the *Atlas* Inertial Guidance System at American Bosch Arma Corporation, my concern in this matter stems solely from my position as a citizen. There is no interest in reopening any industry-versus-arsenal controversy; it is fully appreciated that two of our most effective missile systems, *Sidewinder and Redstone/Jupiter*, are arsenal developments. Nor is it sought either to "shoot down" MIT or to promote my own company's fortunes. The only objective is to see that the most effective system is installed in the *Apollo* vehicle, be it designed by MIT, Arma, Autonetics or any other capable organizations. . . .

At the very minimum, NASA must be compelled to consult independent sources of current performance achievement and have data on all tests, both successful and unsuccessful, presented for objective evaluation. Space Technology Laboratories, in its capacity as technical adviser to the Air Force for the Ballistic Missile Program, constitutes a direct source of data on the *Atlas*, *Minuteman*, and MIT-designed *Thor* and *Titan II* programs available to NASA. This source would also afford a significant buffer to direct contractor promotional efforts. . . .

Frederick J. Howard
Freeport, L.I., N.Y.

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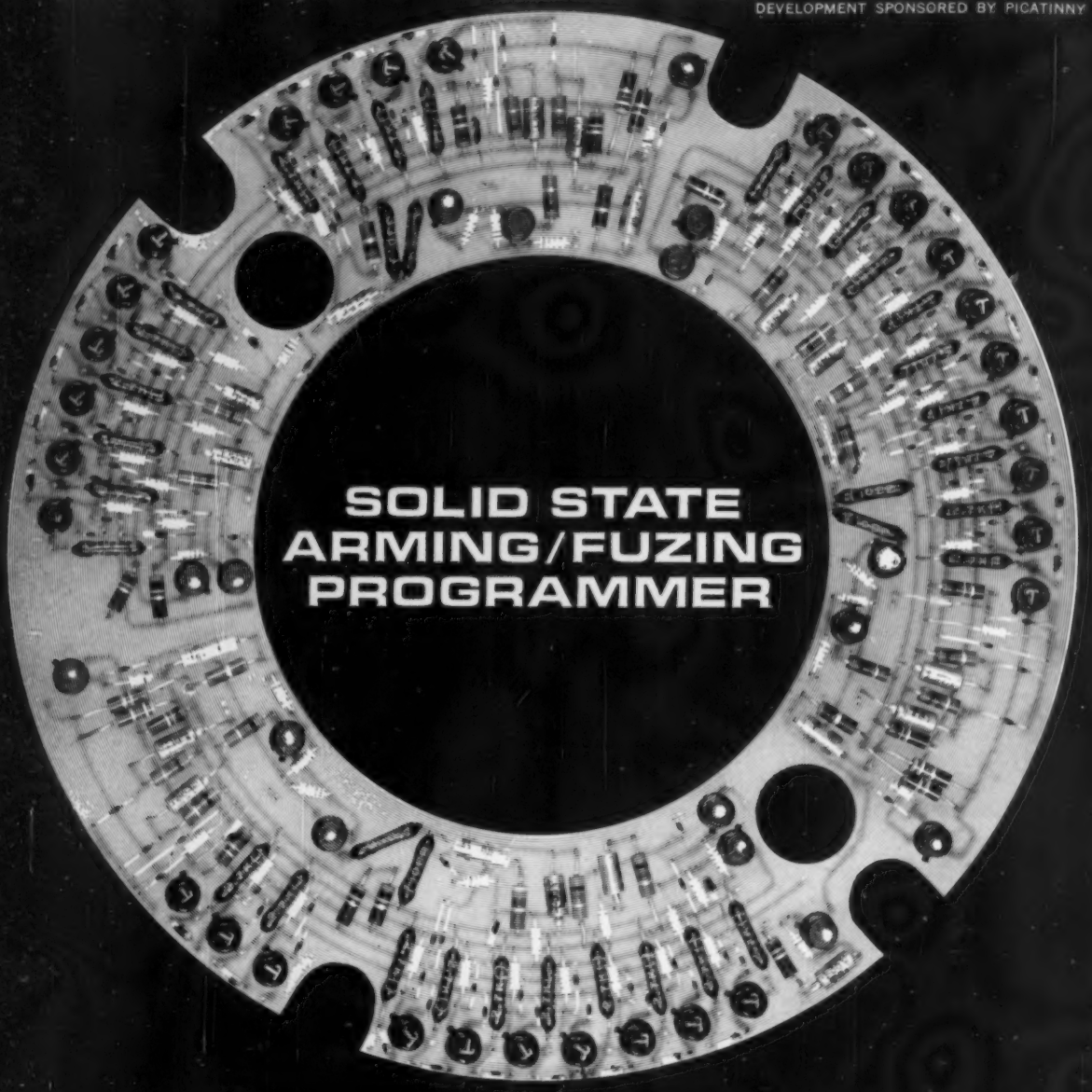

All-electronic digital timing programmer controls atomic warheads with better than 0.1% accuracy under extreme environmental conditions

Developed in cooperation with the U. S. Army Tactical Atomic Warhead Laboratory at Picatinny Arsenal under a program of supporting research, this new digital timing programmer represents a significant advance in the state-of-the-art for arming/fuzing devices. For this particular application, the programmer includes two identical channels, each with a 4-stage, adjustable timing program *accurate to within 0.1%* under any combination of temperature (−65°F to +165°F), voltage (26.5 ±5.5 Vdc), vibration (50 g's/2000 cps), shock and acceleration (100 g's). This new standard of accuracy under rugged environmental conditions is, however, practically meaningless until it is combined with another, equally important consideration always present in modern atomic weapon systems — *reliability*. The programmer's proven solid state design, *without any moving parts*, together with the unique packaging methods utilized, potentially offers a safety-reliability level substantially higher than previously attainable.

This arming/fuzing device is only one specific application of Tempo's exclusive solid state digital programmer design. Circuit versatility permits an almost infinite number of applications. Number of functions to be controlled is limited only by the allowable physical size of the device. Timing increments can be as close as 10 microseconds. Functions can be fixed or variable in time from the application of power or from a control signal. Two basic characteristics, however, are present in all versions; a high degree of accuracy and maximum reliability — both guaranteed under a wide range of extreme environmental conditions. If these characteristics are vital requirements of *your* timing programmer, Tempo can help you.

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The Countdown

WASHINGTON

More Space for the Air Force

Air Force officials are seeking a much stronger voice in NASA's man-to-the-moon operation, including greater use of AF facilities and management capability. Discussions to improve NASA-AF cooperation now are underway. The Air Force is confident that within the next few months it will be assigned a much larger role in the national space program.

Meanwhile, Back at AFSC . . .

The new Bioastronautics Systems Division of the Air Force Systems Command becomes a reality this month. It incorporates all of the Air Force's scattered bioastronautics facilities. With Congress watching closely, the move is certain to make much more difficult NASA's attempts to build up its own bioastronautics capability.

Army R&D: Who Does What

Informed sources have come up with some new figures on where the Army is spending its R&D dollars—all $1.2 billion of them. Some 63.5% is spent with industry; some 36.5% in-house. About one-third of the total Army R&D budget is going to *Advent, Mauler, Pershing* and *Nike-Zeus.*

Slippage of the Month

October is the month when the *Polaris* sub-building program will begin slipping again unless the Administration moves quickly. The problem: no authorization for procurement of long-lead-time items beyond 29 ships. The result: Month-by-month slippage for all ships beyond the 29th.

Scientific Council for Air Force

In an attempt to improve communications between its scientists and technical experts, the Air Force has set up a Council of Air Force Scientists under AF chief scientist Dr. Leonard S. Sheingold. Military director will be Lt. Gen. Roscoe C. Wilson, deputy chief of staff for research and technology. The group is to provide a pool of military and civilian scientific consultants for technical advice and for coordination of technical information.

End-of-the-line Not in Sight

Air Force Vice Chief of Staff Gen. Frederic H. Smith, Jr., is sounding the alarm against consideration of the ICBM as the ultimate weapon. "What kind of a stalemate would exist if we froze on today's weapons and the Soviets developed a defense against the ICBM?" he asks. "Or how would we feel about a 'stalemate' if enemy armed satellites were overflying our cities or bases a mere 100 miles up?"

INDUSTRY

Training for Pershing

A training program is under way at Martin-Orlando for an initial contingent of 250 military and civilian personnel of the *Pershing* missile system. Courses, ranging from 6 to 16 weeks, are designed to teach technical characteristics of the *Pershing* system to Army military and civilian instructors and supervisors who will operate, maintain and support the *Pershing* in the field.

GE's ComSat Out of Business

General Electric is dissolving Communication Satellites, Inc., the corporation created to put GE into the communications field as a carrier. GE has also formally withdrawn its request to take part in operation of a U.S. space communications system. Decision followed the Federal Communications Commission ruling that operation of the system would be limited to international common carriers.

New BMEWS Project Manager

William L. Richardson (Maj. Gen. USAF, ret.) has been named general manager of RCA's Major Defense Systems Division, replacing D. Brainerd Holmes, who will head up NASA's *Apollo* program. Richardson also will serve as project manager for the AF Ballistic Missile Early Warning System (BMEWS).

Tory Tests Beginning Again

Tests of the *Pluto* reactor are being resumed by the Atomic Energy Commission at its Nevada test site. The full-power run of the Tory IIA-1 reactor is the first since May 14.

SLAM Decision Due Shortly

Fate of Project *SLAM*, the supersonic low-altitude missile, hangs on the report of an ad hoc committee due to go this week to DOD's Dr. Harold Brown, director of research and engineering. Best guess on the recommendation: an increase in funding but no okay for a flight test program.

MA-5 Flight Is Set

NASA is pushing industry teams hard to meet an early November target date for orbital flight of the *MA-5*. Best bet is that a monkey will ride the McDonnell capsule, although a final decision has not been made. The NASA schedule calls for three manned *Mercury* orbital flights following the *MA-5* shot. These are to be followed by two more launches which will send crews of two or three monkeys on orbital flights of up to two weeks.

New Oceanographic Sub Scheduled

General Dynamics' Electric Boat Div. will build Aluminaut, an oceanographic research submarine designed to operate at depths of 15,000 ft., for Reynolds International at a price of $2 million. Fifty feet long and with an operating range of 80 miles, it is the first sub ever to be built of aluminum. Launch date: 1963.

INTERNATIONAL

Soviet Protest on West Ford

The Soviet Academy of Sciences has joined in the protests over Project *West Ford*, the U.S. communications experiment designed to sow 350-million copper dipoles in earth-orbit. A letter to the U.S. National Academy of Sciences said the sowing of copper filaments "may have dangerous consequences to artificial satellites, especially those with a man on board."

The Missile/Space Week

S-1^b Bidders to Meet

NASA will hold a bidders conference on the S-1^b stage of the *Saturn* booster in New Orleans on Oct. 4.

No official decision has been announced as to whether the stage will have two or four F-1 engines.

Thirty-two firms attended the bidders conference on the first stage of the *Saturn C-1* booster held there last week.

Twenty-eight companies asked for copies of the specifications. The booster will be built according to Marshall Space Flight Center design but a product improvement program will be undertaken concurrently.

Bids are due on Oct. 16; the contract will be awarded about Nov. 15.

The same 37 firms invited to the C-1 first stage conference will also be permitted to bid on the S-1^b first stage.

The stages will be built by different contractors, however.

The following firms did not ask for C-1 specifications: Bell Aerospace, Firestone, Goodyear, Grumman, Hughes, McDonnell, Raytheon, Sperry Rand, and Western Electric.

Zeus Development Refueled

An additional $171,821,000 contract has been received by Western Electric Co. for continued development of the *Nike-Zeus* antimissile missile. Subcontractors and suppliers in many states will share in the funds.

These include Goodyear Aircraft, Continental Electronics, Avco, Cornell Laboratories, Continental Can, Remington Rand, Sperry Rand, and New Mexico State University. The Army said some of the contract money will be spent at the *Zeus* testing station nearing completion on Kwajalein Island in the Pacific.

More than $1 billion now has been put into *Nike-Zeus* development. (For a progress report on the *Zeus* system, see p. 32.)

Shots of the Week

• Third shot in the current Soviet series of missile firings into the Central Pacific (M/R, Sept. 25, p. 10) impacted in the designated target area southwest of Hawaii on Sept. 21. A Tass report said that in addition to check-out of guidance equipment, the firing was a test of communications equipment for the orbiting of future satellite spaceships. Next Soviet space spectacular may be timed to coincide with the November anniversary of the Russian revolution.

'Significant Milestone'

TITAN I'S 5300-mile flight from Vandenberg AFB to near Wake Island was called by AF "a highly significant milestone at a significant time in history."

• A Martin-built *Titan I* successfully passed its first complete operational systems test on Sept. 23 when it was lifted by elevator from its underground silo for a 5300-mile flight from Vandenberg AFB. Impact was in the target area near Wake Island.

• At Cape Canaveral, Martin's *Pershing* scored its 18th success in 22 test launchings with a 200-mi. flight on Sept. 26. The Army said the firing was a special test to evaluate performance in a relatively short-range trajectory. It said all test objectives were met, including an evaluation of warhead components. Production of *Pershing* is to begin shortly, the Army said.

• Test flight of the North American *X-15*, with Navy Comdr. Forrest S. Petersen at the controls, was cancelled on Sept. 27 due to high cloud cover over Edwards AFB. The flight, to check ability of the rocket plane to withstand 1000°F temperatures, was re-scheduled for the following day.

Entac Builder Disclosed

An unheralded defense company has been identified by the French Armed Forces Ministry as a major manufacturer of the *Entac* antitank missile. More than 10,000 of the missiles have been turned out under the direction of the government prime—Direction d'Etudes et Fabrications d'Armement (DEFA)—which also manufactures the weapon.

L'Atelier de Construction de Puteaux, located near Paris, was identified this week by the Armed Forces Ministry as a main *Entac* manufacturer. DEFA also manufactures the antitank missile, which it designed and which remained under tight security until the U.S. Army decision to purchase $20-million worth (M/R, Mar. 27, p. 14).

Other countries, including Belgium, are reported to be interested in *Entac*, and an additional production source has become necessary. Nord Aviation has been selected to produce *Entac* starting early in 1962.

Nord has considerable experience in this field, having built an antitank series and air-launched missile. DEFA has designed several different *Véronique* research rockets and the widely used solid-fuel *Parca*, a mobile Army surface-to-air training weapon. It is also developing a "super" *Parca* for defense against high-altitude, high Mach aircraft.

The French Ministry said "Delivery of *Entac* missiles to the U.S.A. in December, 1961, will be effected by DEFA."

Figures on *Entac* performance show a range of about 1 mile and a speed of 180 mph.

Mars-Venus Life Probe Set

NASA plans to launch a search for life on Mars and Venus in 1966-67. A $380,640 contract has been

awarded to Stanford University for design of a device which can examine microscopic organisms or chemicals for traces of nucleic acids, basic to all living matter. The instruments, equipped for telemetry, will be landed on the planets by space probes.

"If life exists or has existed on a planet, evidence would be found in any drop of water, pinch of soil or gust of wind," says Stanford's Dr. Joseph Lederberg. The professor of genetics, winner of the 1958 Nobel prize in medicine, is working on the project with Dr. Elliott C. Levinthal, research physicist.

DOD Intelligence Leaks

The Defense Department is trying to cut down on dissemination of data on new weapons. Arthur Sylvester, assistant secretary of defense for public affairs, says DOD is taking steps to close up the sources and methods by which intelligence information is getting out.

His remarks came shortly after the House Information Subcommittee released its six-month assessment lauding Kennedy Administration information policies. The report said the Administration got off to a confused start but now has resolved to protect the people's right to know the good and bad of U.S. military security.

The subcommittee, headed by Rep. John Moss (D-Calif.), admitted, however, that it was unsuccessful in lifting the Navy's classification of its telephone book.

Front Office Changes

Robert C. Jackson will become president of Ryan Aeronautical Co. on Nov. 1. His election was announced last week by T. Claude Ryan, who will step down as president of the firm but retain his positions as chairman of the board and chief executive officer.

JACKSON

Jackson has been executive vice president of Ryan for the past two years, following his 1957 appointment as a director. As a graduate of Stanford University in 1929, he studied at the Harvard Graduate School of Business and then returned to Stanford to take his master's degree at the business school there. Before joining Ryan, Jackson was connected with a number of Southern California firms.

At Curtiss-Wright Corp., I. Nevin Palley was named executive vice president. Palley formerly was president of ITT-Federal Laboratories.

At Northrop Corp., Dr. William F. Ballhaus, executive vice president, was elected to the company's board of directors to fill the vacancy created by the death of Dr. Howard P. Robertson.

Soviets Arrive for IAC

Nine Russian space scientists are expected to attend the 12th International Astronautical Congress, opening in Washington Oct. 2. Chairman of the conference is Prof. Leonid I. Sedov of the Soviet Academy of Sciences. More than half of the 200 technical papers to be presented at the five-day session are by non-American experts.

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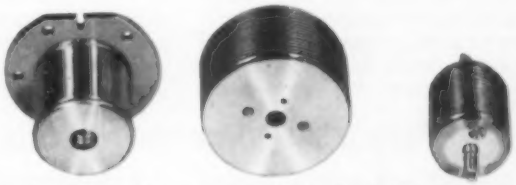

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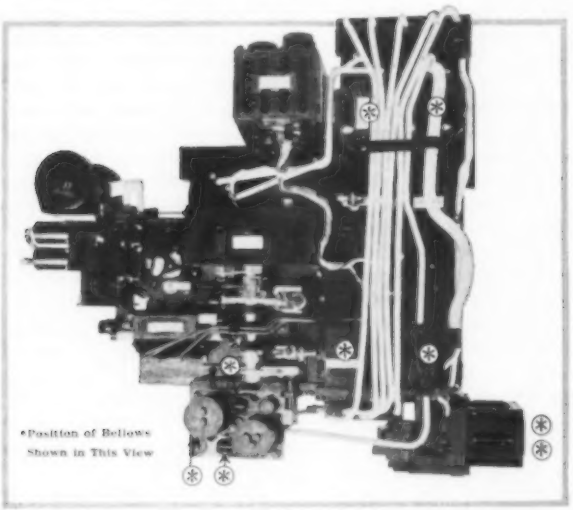

As Seen In a B-70 air inlet control by Hamilton Standard

There are twenty three welded diaphragm bellows in the air inlet control shown here. The assembly includes eight different bellows engineered expressly for the installation.

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For fiscal 1963 . . .

DOD, NASA May Ask for $55.5

Services working with new 'program decisions' handed down by McNamara; deeper crisis would swell total

by James Baar

THE PENTAGON is now moving toward proposing a Fiscal Year 1963 spending budget of around $52 billion.

At the same time, NASA is considering a FY '63 budget totaling around $3.5 billion.

Both figures are still tentative. They could be altered radically by such unresolved matters as the Berlin crisis, arms control and the military role in the U.S. space program.

However, Defense Secretary Robert S. McNamara last week took a long stride forward in the FY '63 budget-making process by sending the military services his much-awaited "program decisions"—his decisions on the military forces that he thinks the nation should maintain and build.

Informed sources indicated that a considerable part of the increased defense spending would be for procurement of additional *Polaris* submarines and *Minutemen*—probably fixed-base. Some experts are contending the expected increase in the size of Soviet nuclear warheads is making the mobile *Minuteman* more vulnerable than superhardened fixed bases.

The military services have been directed to submit budgets to match the programs within about one month. Then the Defense Department will begin its usual review of the total defense budget requests with the Bureau of the Budget.

This procedure of submitting budget requests on the basis of previously determined programs is a sharp break with the past.

• **New stress on programs**—Previously, the Defense Department after consultation with the White House gave the military services budget guidelines in terms of dollars. For example, last year the services were instructed to submit three budgets: one based on the dollar total of their FY '61 budget; one based on a cut in the FY '61 budgets; and one based on an increase.

Military programs, despite occasional pious denials, were trimmed and molded to fit the dollar totals.

McNamara and Pentagon Comptroller Charles J. Hitch have reversed this procedure, at least to a considerable extent. This has been done by adopting many of the approaches advanced by Hitch last year in a book resulting from Rand Corp. studies.

Under these approaches, programs would be determined first on the basis of the cost effectiveness of alternative program levels. Then budgets would be put together to match the approved programs.

In April, Hitch directed that the various units of the Armed Forces be regrouped for budgetary purposes into program packages based on common missions. The program packages, in turn, were to be made up of program elements such as B-52 wings, infantry battalions and ICBM squadrons.

He directed that the total cost of the elements and packages were to be determined not only for FY '63 but for the next five to 10 years. This would make it possible to determine the cost

Potent Arguments for Bigger Military Space Program

CURRENT AIR FORCE pressure for a greatly expanded military space program would—if successful—bring about considerable revisions in Defense Department budget plans over the next several years.

Many of the arguments advocating such a military space program were stated publicly in the bluntest terms to date during a high-powered panel discussion at the recent Air Force Association Convention in Philadelphia.

Here are some of the key statements made by panel members.

Dr. Walter Dornberger, vice president of Bell Aerosystems Co. and former head of the German *V-2* program:

"We can be sure that the Communists have realized that a military stalemate now exists, which may prevent them from ever achieving their goal through conventional political or military means. . . . In such a situation the Russians would be utterly foolish not to direct their efforts toward military superiority in space. According to Khrushchev's repeated statements, they are convinced they are ahead of the free nations of the world in the conquest of this space. Here, I am sure, the Russians recognize an opportunity for obtaining a new and unique military superiority.

"Besides many others, reconnaissance, weather, navigation, communication and detection satellites the same as spacecraft for bombardment, inspection, interception, command, maintenance and supply could contribute to this military space force. If an enforced agreement with Russia about the peaceful use of space cannot be obtained, we will find one day this variety of defensive and offensive weapon systems established and ready to operate. . . ."

Dr. Edward C. Welsh, executive secretary of the National Aeronautics and Space Council:

"In my view, we do not have a division between peaceful and non-peaceful objectives for space. Rather, we have space missions to help keep the peace, and space missions to help increase our ability to live well in peace.

"The Communists have expressed their determination to dominate the world, and they will use all methods available for attaining that objective. . .

"You may be sure that they are not spending such effort and resources unless they believe firmly that it can be justified in terms of world domination. Manned spacecraft can be used, in the hands of aggressors as well as in the hands of defenders, for active military purposes. In the hands of Communists, they can also be used for blackmail purposes."

Trevor Gardner, chairman of the board and president of Hycon Manufacturing Co., former Air Force Assistant Secretary for R&D and joint author of the recent and still secret Air Force Gardner Report on military uses of space:

"We cannot afford to continue to lag in the field of military space development. Our President has already com-

5 Billion

of various program levels and alternatives.

Then the military services were directed to submit their program proposals for FY '63 along with plans for the next five years, and each service reviewed and commented on the proposals of the other two.

It was on the basis of the proposals and comments that McNamara made his program decisions.

• **Figures still in mind**—No one—least of all, Hitch—would contend that the program decisions were made without thought of the total budget which they would necessarily produce.

McNamara has been in informal contact with the Bureau of the Budget and others in the Kennedy Administration on the question of the FY '63 budget, and he certainly has some idea of the approximate size that would be acceptable.

By the same token, the military services certainly had a general idea of budget totals in mind while drawing up program proposals. And, as one official put it: "The services used to submit very large budgets, now they submit very large program proposals."

Charles J. Hitch

COMPTROLLER changed DOD budget making.

But the emphasis is now considered to be on programs—not dollar totals that can be trimmed 5 or 10% with the reprograming figured out later.

McNamara and Hitch are expecting few program changes during the budget review with the White House unless they are forced by such things as a worsening of the Berlin crisis or the outbreak of new troubles in Southeast Asia or the Middle East.

If the international situation should deteriorate further, program levels are expected to rise and carry the budget with them to considerably higher levels.

However, to date the planned FY '63 additions to the Kennedy FY '62 defense programs are not expected to add more than several billion dollars to the cost of continuing present program levels in the new fiscal year.

Total defense expenditures for FY '62—including some $225 million for civil defense—are expected to run to about $47 billion—a $4-billion increase over spending in FY '61.

Pentagon spending in FY '63 even without any new increase in programs is expected to rise to nearly $50 billion. The cost of increases now planned—possibly as much as $2 billion—must come on top of the $50 billion that is already built into the defense budget.

• **Fiscal confidence**—The prospect of the defense budget rising from the low $40 billions to the low $50 billions in one year does not alarm Hitch. He sees no threat to the economy, as did many in the Eisenhower Administration.

Hitch put his view of the subject bluntly in his book, "The Economics of Defense in the Nuclear Age:"

". . . Growth of the economy of the United States would by itself permit increases in defense outlays up to about $10 billion per year. If we wished to do so, therefore, we could raise the annual defense budget by $20 billion in two years' time without cutting aggregate consumption, investment or civil government programs. . .

"In brief, our national security budget is not near any physical limits. . ." ⌗

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mitted the nation to a major national effort in space exploration—the lunar landing and return program. Our national leaders are now confronted with the need for a similar commitment with respect to U.S. military space superiority. . .

"In view of recent Soviet behavior concerning resumption of nuclear tests, a real possibility exists that a forthcoming test in this new ICBM series could involve the explosion of a giant nuclear warhead, instead of a dummy payload.

"In the face of these two test programs and their grim implications of large thermonuclear bombs in orbit or in ICBM's, we must solemnly re-examine our military defensive and offensive space plans and urge our national leaders to permit us to embark upon a new and invigorated military space program.

"We must also re-examine our civilian space program (particularly the lunar program) so that we will gain the maximum military yield. . .

Gen. Bernard Schriever, commander of the Air Force Systems Command:

"I believe the threat to our national security discussed by the other panel members is a major cause for concern. The development of effective functional capabilities in space will be a principal factor in the continuing struggle for leadership of the world. . .

"There is no short cut to the creation of a team of dedicated and experienced men with a tradition of accomplishment. The Air Force has a highly competent team trained in the skills required to develop the necessary military capabilities in space. These people are accustomed to working with the sense of urgency necessary in programs vital to the national security. . .

"The United States has been notably slow to recognize the military application of new inventions. This was an adequate philosophy for the days when oceans were real barriers and gave us time to mobilize after the outbreak of war. But today, technological surprise could be fatal.

"Two of the most significant technical achievements of this century—the airplane and the liquid-fueled rocket—are American inventions. Yet in each case their first military application was made by other nations."

Rep. Emilio Q. Daddario (D-Conn.), member of House Space Committee:

"People cannot believe that the Russian space effort, once fully developed, will not be used for military purposes. . .

"I have for some three years now heard conflicting and diverse views as to how this threat should be met. Indeed, I have often heard it pronounced that the Russians have no intention to use their space capabilities for military purposes. If we were to follow that school of thought, we could one day wake up to a sky full of armed satellites hovering impregnable in space over the critical centers of the free world, and from that moment freedom would be lost forever. . ." ⌗

Holmes promised power . . .

NASA Realigns to Push Moon Program

Thomas F. Dixon
Deputy Associate Administrator

Dr. D. Brainerd Holmes
Director, Manned Space Flight

Dr. Homer E. Newell
Director, Office of Space Sciences

Ira H. Abbott
Director, Office of Advanced Research

Super management group established to run Apollo called similar to Navy's Polaris direction—but with one major difference; Holmes outlines functional approach to job

by Hal Taylor

THERE'S NO SLOT for a "Moon Boss" in NASA's new organizational setup, but space agency officials declare that D. Brainerd Holmes, director of manned space flight programs, will have the authority to get the job done.

Dr. Robert C. Seamans Jr., NASA's associate administrator, says, "he (Holmes) is the closest thing to a Czar in the *Apollo* program."

A quick look at NASA's new organizational chart—effective Nov. 1—leaves the clear impression that the triumvirate of Seamans, Administrator James E. Webb and Deputy Administrator Dr. Hugh L. Dryden will be the real powers behind the U.S. moon program.

This is denied emphatically by Seamans.

"The only way the program can work," he declares, "is to define Holmes' responsibility and give him the ball. I can assure you, that is how we'll operate."

• **Functional philosophy**—Holmes, general manager of RCA's Major Defense Systems Division, was named to his new post Sept. 20 (M/R, Sept. 25, p. 10) and will take office Nov. 1.

He outlined his own management philosophy this week in an interview with MISSILES AND ROCKETS. He said he usually favors a functional (launch vehicle group, spacecraft group, etc.) arrangement as a technique.

"First, I work out a logical organization without regard to people," Holmes said. "Then I modify it to fit the personnel available." This is the approach he took as project manager for the vast organization employed on BMEWS (Ballistic Missile Early Warning System).

Holmes feels his job is "to direct a program management group which will coordinate NASA resources for, control the budget for, and be responsible for all U.S. efforts to get a man in space."

Shortly after the Holmes appointment, NASA announced organizational and personnel changes designed to give the space agency a managerial capacity to run all future U.S. manned civilian flight programs.

• **Realignment**—Major changes under the new setup include:

—Thomas F. Dixon, director of the office of Launch Vehicle Programs, to Deputy Associate Administrator. In addition to serving as Dr. Seamans' chief assistant, Dixon will be responsible for development of launch vehicles smaller than *Saturn*-class boosters. The office of Launch Vehicle Programs was abolished.

—Dr. Homer E. Newell, Deputy Director, Office of Space Flight Programs, to director of the new Office of Space Sciences.

—Ira H. Abbott, director of the Office of Advanced Research Programs, to director of the new Office of Advanced Research and Technology.

—Dr. Abe Silverstein, director of the Office of Space Flight Programs, to director of the Lewis Research Center, Cleveland, Ohio.

—Robert R. Gilruth, director of the Space Task Group, Langley Field, Va., and NASA's *Mercury* program, to director of the new Manned Spacecraft Center, Houston, Tex.

—A new Office of Applications, established, with a director still to be named.

• **Special twist** — Both government and industry leaders advised NASA that the only way to beat the Russians to the moon was to set up a "Special Projects" type agency responsible only for the *Apollo* program, with one man in control of every facet and key decision.

Webb decided instead on a refinement of this approach. Killing the idea of a special projects office, he decided to set up a super management group, which would have to report to Seamans, Dryden and himself (M/R, July 17, p. 56).

The new Office of Manned Space Flight Programs will not only run the

Apollo program, but also be capable of growth and have a built-in capacity to manage any future U.S. manned flight programs. At the same time, Webb ordered that the Directors of NASA's various research centers would also have to report directly to Seamans.

According to Seamans, the new organizational structure is necessary because "manned space flight is a tremendously large technical endeavor which will require a large amount of effort and work at all NASA centers."

"This is the only way," he continued, "that we can draw on all the resources to get the job done."

The center directors will have a say in NASA's policy planning for future space programs, he said. They will not be drawn into the program management of current programs, he added, and they will not be able to second-guess the directors of the four program offices.

Holmes' new directorate will be responsible for overall systems engineering and evaluation for the various manned space flight projects, including the spacecraft, all launch vehicles of the *Saturn* and above classes, ground support equipment, tracking stations and communications network.

Its first job will be to define the real objectives of manned space flight including lunar exploration and earth-orbiting flights. Then it will have to block out the tasks and assign the work to the centers.

• **Like Polaris, but**—Seamans said the new NASA organization gives the Manned Space Flight Office essentially the same makeup as the Special Projects Office of the Navy *Polaris* program.

There is one main difference, however. Adm. William F. Raborn, head of the *Polaris* program, could go directly to industry to award contracts. Under the NASA arrangement, the various research centers will still be responsible for contracting.

It is also apparent that many of the basic decisions in the *Apollo* program will be made before Holmes takes over on Nov. 1. These include such things as the size of boosters, spacecraft, and whether rendezvous or direct descent will be used in the moon program.

Under the reorganization, the other three main program office responsibilities line up like this:

—Office of Applications will have control of the communications and meteorological satellite programs.

—Office of Space Sciences will be responsible for unmanned scientific investigation of space, the moon and the planets — including the *Surveyor*, *Ranger*, *Mariner*, *Orbiting Geophysical Observatory*, *Orbiting Solar* and *Astronomical Observatory* satellites, and all sounding rocket programs.

—Office of Advanced Research and Technology will control the *Rover* nuclear energy program, *SNAP* and the development of advanced propulsion.

—Office of Manned Space Flight will have a top management structure including a systems engineering group, a launch vehicle organization to develop the *Saturn*-and-above boosters, and a spacecraft group which will draw heavily on the *Mercury* Program staff.

• **To be resolved** — While the NASA reorganization has been tied up fairly neatly, there are some loose ends:

—No decision has been made yet as to who will do the systems engineering in the Manned Space Flight Office. Under the *Polaris* program, an industrial contractor, Vitro, was given the job. NASA officials favor having the new group do their own systems engineering, using "in-house" personnel. Space agency officials hope to get the aid of the Defense Department in staffing the group.

—No one has been selected to head the Office of Applications. NASA officials reportedly favor an industrial executive who has experience in the commercial communications field. It is also understood that NASA Administrator Webb would like John J. Burke, Jr., executive vice president of the Siegler Corp., for the post. Burke is scheduled to take a temporary consultative position with NASA before finally deciding whether he wants the job. ¤

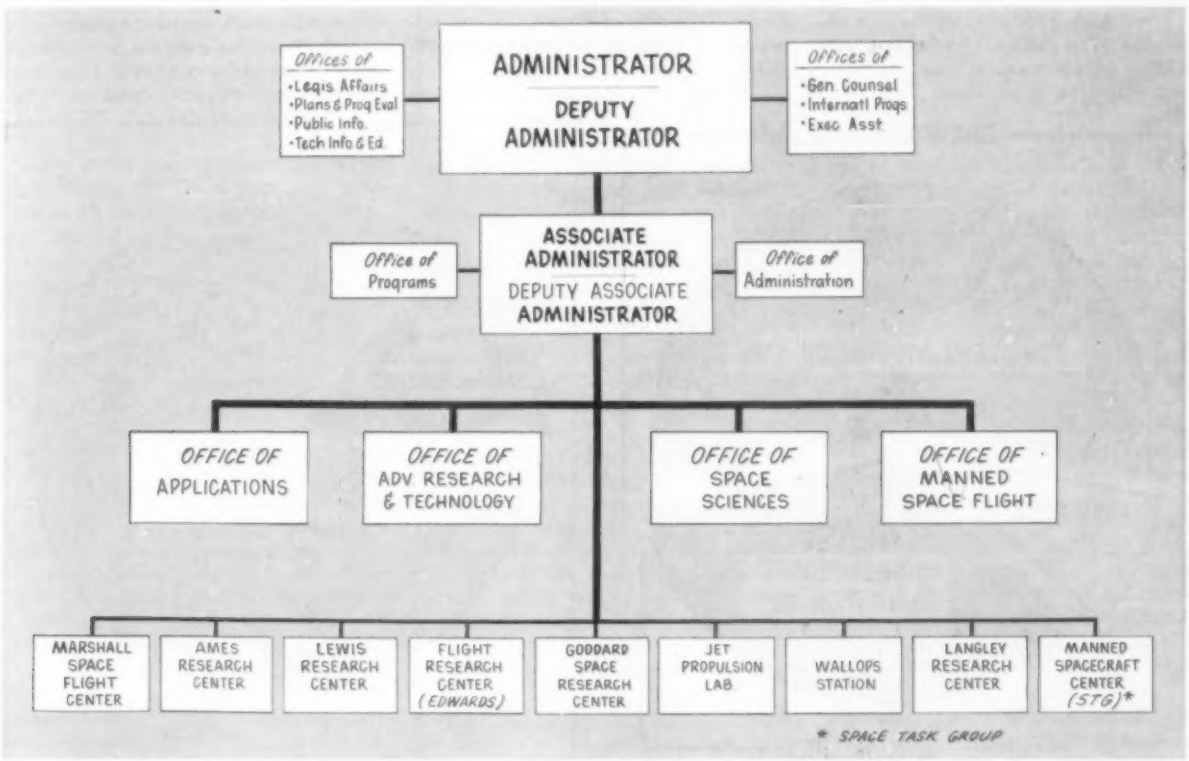


CHART SHOWS how NASA has reorganized to stress key programs—especially Apollo.

New report reveals . . .

NAA by Far Biggest NASA Contractor

McDonnell was runner-up; total procurement reached $756,000,000; small firms won 15% of money spent

NORTH AMERICAN Aviation, Inc, top NASA contractor in Fiscal 1961, received more than one and a half times as many NASA procurement dollars than its closest competitor, McDonnell Aircraft Corp., according to the procurement report just released by the space agency.

NAA cornered 18% of the direct awards over the past year—a percentage representing some $75 million in procurement actions. McDonnell, its closest competitor, received some $41.8 million —10% of the direct awards.

Other highlights of the procurement report:

—NASA procurement for FY '61 totalled $756 million, representing some 94,000 procurement actions.

—Of this total, some 56% were placed directly with business firms, 12% under NASA's contract with Jet Propulsion Laboratory, 3% with nonprofit institutions or organizations and 29% with or through other government agencies.

—Direct awards to Small Business totalled about 15% and, of the awards to large businesses, it is reported that approximately 20% of these contracts went to small businessmen.

—Approximately 32% of NASA procurement actions were placed in substantial labor surplus areas.

• **Extent of competition**—Of the $423.3 million in direct contract awards by NASA, approximately 9% were placed through formal advertising for competitive bids, 56% through competitive negotiation and 35% by noncompetitive negotiation. The high percentage of negotiated contracts results from the fact that much of NASA procurement is for research and development effort on a cost-reimbursable basis. This type of contract is not permitted in formally advertised procurement.

During FY '61, Source Evaluation Boards — composed of government scientists and engineers versed in the technical details of the proposed procurement and representatives of government business management staffs—were used in connection with the award of 18 new contracts, totalling about $30 million.

By far the majority of NASA awards (83%) were placed on a cost-plus-fixed-fee basis. About 16% of the awards were on a firm fixed-price basis, while the remaining 1% included: actions on cost (no fee), cost sharing, fixed-price-redeterminable, fixed-price-incentive and time and materials contracts. However, since awards under $25,000 are not included, the fixed price category, as a percentage of the whole, is understated.

On the basis of estimated costs, the CPFF contract yielded the contractor a fee of from six to eight percent with the bulk of the fees (65%) averaging between six and seven percent.

• **Non-profit contract awards** — Of the $24.5 million awarded to non-profit institutions or organizations, $13.7 million covered research contracts. Ap-

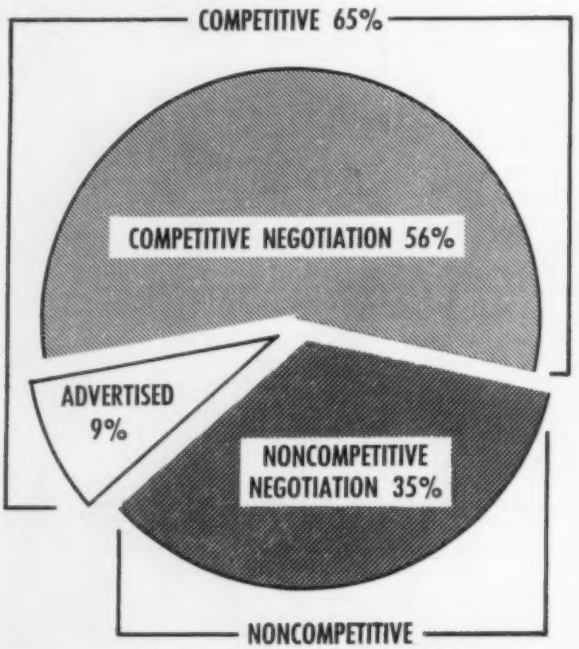
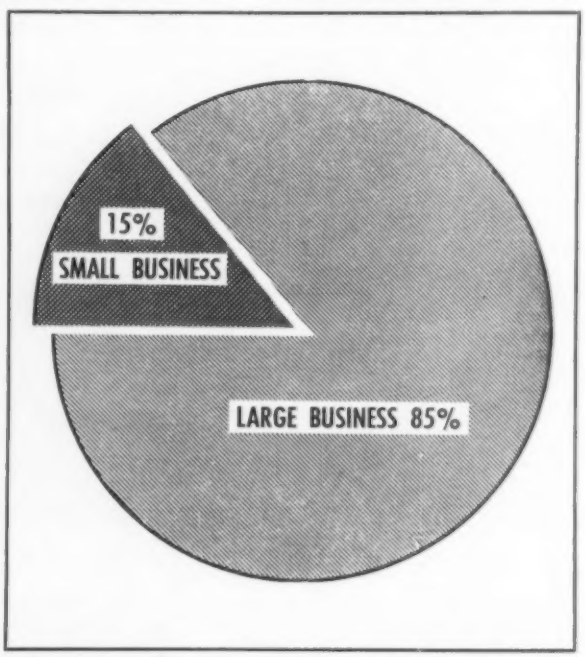


CHART SHOWS 35% of awards negotiated noncompetitively.



SMALL BUSINESS won 65% of contracts, 15% of dollar total.

or in FY '61

proximately 66% of the actions were on a cost (no fee) basis, 24% on a cost-plus-fixed-fee, 8% on fixed-price and the remaining 2% on time and materials and labor hour contracts. The CPFF award yielded an average fee of 6.01%.

The remaining $10.9 million of the awards to non-profit organizations represented research grants.

The leading nonprofit institutions for FY '61 were: MIT, U. of Michigan, U. of New Mexico, U. of Alaska, Cornell Aeronautical Lab, Rand Corp., Battelle Memorial Institute, Stanford Research Institute, Princeton, and the State University of Iowa.

The Jet Propulsion Laboratory, operated for NASA by the California Institute of Technology, received approximately $86 million during the year. These funds provided the basis both for the laboratory's research efforts and for improvement, modernization and expansion of JPL facilities.

• **Awards to government agencies**—Of the $221.6 million placed with or through other government agencies, approximately 64% went to the Air Force for the *Saturn, Centaur, Atlas* booster and *Agena* programs. The Departments of the Army and Navy, the Atomic Energy Commission and Commerce Department won other awards.

The philosophy behind this large amount of procurement through DOD is to avoid duplication of effort and to achieve effective utilization of both agencies' resources.

During the past year NASA has resorted to letter contracts in 57 instances, with a total dollar value of about $55.1 million. Of these only nine had been firmed up by the end of the fiscal year: 48 contracts, with a total dollar value of $46.6 million, had not been finalized.

• **Procurement by R&D program**—Approximately 85% of NASA's procurement during the fiscal year was funded from its R&D appropriation. Vehicle development received 30% of this total for the development, fabrication and launching of space vehicles including the *Scout, Delta, Centaur* and *Saturn* vehicles. The *Saturn* and *Centaur* accounted for 92% of the procurement in this area. Scientific investigations of space, utilizing sounding rockets, earth-orbiting satellites and lunar and planetary probes, consumed 17% of the R&D procurement dollar, while Space Propulsion Technology and Manned Space Flight received 13 and 11% of the total R&D procurement.

• **Major awards in FY '61**—During the year, ten new contracts of over $5 million each were awarded directly to business firms. The total dollar value of these awards was approximately $87.4 million.

Leading all other contractors was North American Aviation, Inc., with three major pacts for the development of a 200,000-lb.-thrust liquid oxygen-liquid hydrogen engine, the design and development of the H-1 engine for *Saturn* and the fabrication and production of H-1 engines and related spares for the *Saturn* program.

Other leading industrial concerns were Chrysler Corp., Hayes Aircraft Corp., STL, Aerojet, Chance Vought, Grumman and Brown Engineering.

Carry-over contracts for work already in progress were awarded to five major business firms. Again North American led with an award of $73.9 million for further work on the 1.5-million-pound-thrust engine. McDonnell received $41.6 million for continuing work on the *Mercury* program, while Western Electric was awarded $26.5 million for maintenance of the *Mercury* tracking and ground instrumentation system. Douglas received two awards: $22.4 million to design, develop and test the *Saturn S-IV* stage vehicles and $7.8 million for design, development and launch of *Delta* three-stage vehicles.

• **Leading states**—The four states receiving the largest share of NASA procurement awards, and total dollar value of these pacts, were: California, $148.7 million; New York, $43.9 million; Missouri, $42.5 million; and Alabama, $37.1 million.

Of NASA's direct awards of $25,000 and over, $92 million, or 32%, were placed in areas which were designated by the Department of Labor as substantial labor surplus communities. ■

Twenty-Five Contractors Listed According to Net Value of Direct Awards
Fiscal Year 1961

Contractor	Net Value of Awards: Thousands of Dollars	Net Value of Awards: Percent of Total Awards to Business	Net Value of Awards: Cumulative Percent	No. of Contracts
Total	$423,294	100		
NORTH AMERICAN AVIATION INC.	75,009	18	18	21
McDONNELL AIRCRAFT CORP.	41,843	10	28	4
DOUGLAS AIRCRAFT COMPANY	30,698	7	35	8
WESTERN ELECTRIC COMPANY	26,609	6	41	3
SPACE TECHNOLOGY LABORATORIES	13,098	3	44	11
CHRYSLER CORPORATION	12,922	3	47	9
GRUMMAN AIRCRAFT ENG., CORP.	11,168	3	50	3
THE HAYES CORPORATION	10,278	2	52	4
GENERAL ELECTRIC COMPANY	9,197	2	54	30
CHANCE VOUGHT CORPORATION	8,773	2	56	12
RADIO CORPORATION OF AMERICA	8,580	2	58	31
BROWN ENGINEERING CO., INC.	6,680	2	60	2
BENDIX CORPORATION	6,481	2	62	16
AEROJET-GENERAL CORPORATION	6,286	1	63	14
LOCKHEED AIRCRAFT CORPORATION	3,335	1	64	13
MINN. HONEYWELL REGULATOR CORP.	2,730	1	65	14
NORAIR ENGINEERING CORPORATION	2,512	1	66	3
GENERAL DYNAMICS CORPORATION	2,135	1	67	17
FLEXONICS CORPORATION	2,128	1	68	2
BALL BROTHERS RESEARCH CORP.	2,025	*	68	4
UNITED ENG. & CONSTRUCTORS, INC.	2,000	*	69	1
COLLINS RADIO COMPANY	1,994	*	69	3
ARTHUR VENNERI COMPANY	1,969	*	70	1
CARL N. SWENSON COMPANY	1,835	*	70	3
AMPEX CORPORATION	1,685	*	70	20
OTHER	131,324	30	100	

* Less than one half of one percent

nasa's apollo program/$20 billion for industry

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Technical Countdown

ELECTRONICS

EIA Attacks NASA Patent Policy

NASA's proposed patent policy, if used generally by all Federal agencies, would effectively make the government a total economic dictator and end the free enterprise system, says an Electronics Industries Association official. The proposal basically covers the grant of exclusive licenses to individual manufacturers for the use of NASA patents. Elmer J. Gorn, chairman of EIA Patents Committee, told a recent NASA hearing on patent regulations that the only workable policy is to grant the people of the United States ". . . the right to practice inventions covered by U.S.-owned patents freely, unconditionally, and without charge."

Rugged Missile Programer Developed

A new solid-state digital timing programer, designed for missile arming and fuzing control, provides an accuracy of better than 0.1% even under extreme environmental conditions. Built by Tempo Instrument Inc. for Army Ordnance Corps' Picatinny Arensal, it has operated in temperatures from −65 to 165°F, withstood vibrations up to 50-g at 2 kc, and survived shock and accelerations to 100-g, the company says. Poorest timing error over the longest test period (109.9 sec.) was only 0.024% — or 27 msec.

SUPPORT EQUIPMENT

Soviets Develop Pneumatic Computer

A miniature pneumatic computer—capable not only of performing simple arithmetic operations but also of solving integral and differential equations—has been developed by a Soviet scientist, according to a report in the *Ekonomicheshava Gazeta*. The computer consists of a set of metallic washers with diaphragms made of rubberized linen. The washers form miniature chambers which receive the inflow of compressed air. The operation of the device is controlled by means of stop-cocks built into the tubes carrying the compressed air.

Vostok II Communications Described

The system used for communication between *Vostok II* and earth, according to *Izvestia*, consisted of two AM, short-wave telegraph-telephone transmitters operating in parallel at 15.765 mc and 20,006 mc through special separation filters (duplex) with a common antenna. A third transmitter —an FM, 143.625-mc device operating within a ±30-kc bandwidth with a special antenna—was used during the vehicle's flight over the USSR.

Phased-array Radar Advanced

Phased-array radar evaluation, performed by Sylvania at Waltham, Mass., as part of its work in ARPA's Project *Defender*, has created new concepts of long-range missile detection and tracking. The experimental system CODI-PHASE (Coherent Digital Phased Array System) is believed to offer a simpler, more efficient, less costly approach to rapid simultaneous search-track of multiple missile targets. The heart of the technique is its use of digital computer circuits for radar return signal processing and control. Sylvania says the system has superior accuracy and resistance to electronic countermeasures.

Electrothermal Rock-crusher Feasible

Recent test reports by General Electric and the Montana School of Mines show that high-energy radio-frequency power can be used to break rock faster and more economically. Called electrothermal forcing, the technique makes use of water of crystallization as an r-f conductor between electrodes attached to the rock. The resulting thermal stress along the path of conductivity will split or even shatter rock (depending on the applied force) in seconds, whereas conventional techniques may take days. An r-f current from 20-40 mc and about 25 kw of power is sufficient, the report says.

ASW & SEABORNE ENGINEERING

ASW Drone Nears Completion

First units of the airborne/shipboard digital communications system for the Navy's Drone Anti-Submarine Helicopter (DASH) have just been delivered to Gyrodyne Co. by Motorola. Gyrodyne is developing DASH, which will be capable of seeking out and destroying enemy submarines. The Motorola system provides remote radio control and digital data processing and computation for maneuvering the DSN-3 drone for weapons release.

PROPULSION

Orbiting "Gas Stations" Suggested

An analysis of the fuel requirements for a flight to the moon and back, and the resultant weight of the take-off vehicle, has led one Soviet scientist to suggest the use of satellites as intermediate fueling points. Writing in the *Ekonomicleskaya Gazeta*, N. Varvarov considers the projected velocity requirements of various phases of the lunar mission—and concludes that the launch vehicle weight would be an "impossible" 10,000 tons.

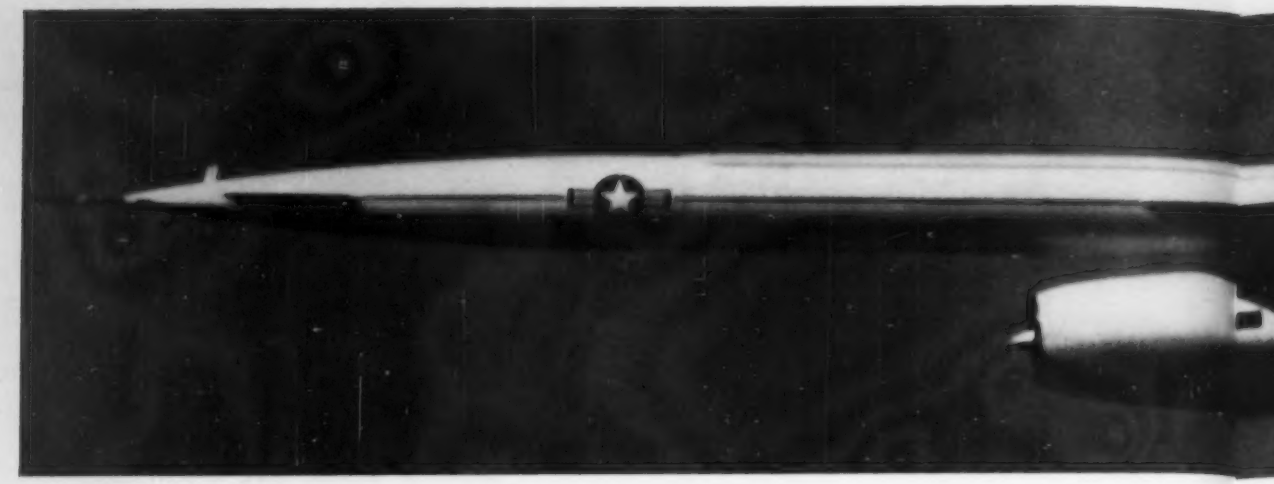
ADVANCED MATERIALS

Solution to Corrosion in Offing?

A new technique for studying surface reactions on materials, developed by scientists at Bell Telephone Laboratories, gives a detailed view of atomic arrangements in such reactions. Low-energy electrons are diffracted from a surface and accelerated to a fluorescent screen, using a strong electric field. The pattern produced gives the arrangement of the first monolayer of surface atoms. The technique opens the door to better understanding of such surface phenomena as catalysis and corrosion, Bell reports, and should permit revolutionary advances.

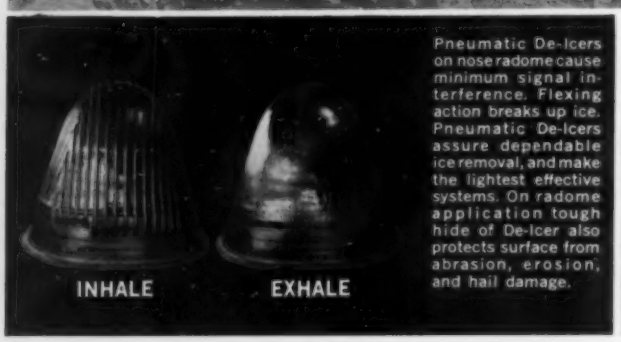
Bell Rings Twice

Another advance revealed by Bell Labs is the use of yttrium iron garnet (YIG) in microwave applications. Recent studies indicate YIG is substantially better than conventional ferrites. Both can be employed for microwave transmissions with low loss and as isolators for one-way transmission lines, among other uses. Both materials are ferrimagnetic, but YIG is a better electrical insulator. Further, YIG resonance-peak linewidth (0.14 oersted at 20°C and 6000 mc) is narrowest ever reported for any ferrimagnetic material.



B.F.Goodrich develops versatile systems for
ICE PROTECTION

HIGH PRESSURE PNEUMATIC DE-ICERS equip the wing and tail leading edges of Lockheed C-140 JetStar. System was chosen for light weight and simplicity.



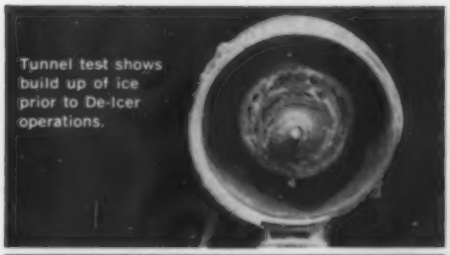
Pneumatic De-Icers on nose radome cause minimum signal interference. Flexing action breaks up ice. Pneumatic De-Icers assure dependable ice removal, and make the lightest effective systems. On radome application tough hide of De-Icer also protects surface from abrasion, erosion, and hail damage.

FLYING TV specially equipped casts. Two pneumatic 23-foot antenna.

ANTENNA is kept ice-free on this DC-6AB used for educational broad- De-Icers cover the leading edge of the Pressure is cycled in spanwise tubes.

ELECTRO-THERMAL DE-ICER SYSTEMS KEEP "HOUND DOG" NOSE WARM

To keep this North American Aviation missile's engine ready for instant launching despite freezing conditions, BFG electro-thermal units are installed on the nose cone, supporting struts and ram air probes.

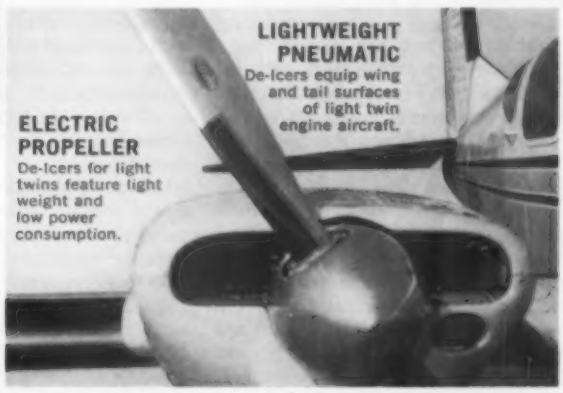


Tunnel test shows build up of ice prior to De-Icer operations.

Stainless-steel-clad heating elements protect engine air intake.

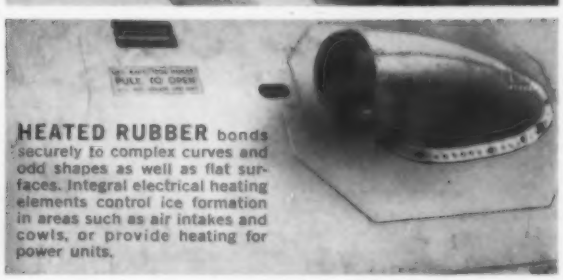
Since introducing the first pneumatic De-Icers for aircraft over thirty years ago, B.F.Goodrich has developed a broad capability in ice protection systems: *Pneumatic De-Icers* are used on high performance aircraft like the Lockheed C-140 JetStar...and designed as lightweight systems for small twins. *Metal Clad Electro-Thermal De-Icers* can be adapted to airfoil shapes, and in many cases can serve as structural members. *Heated Rubber* is adaptable to fit complex curves or odd shapes for localized heating. *Reinforced plastic parts*, integrally heated, are available for applications not subject to severe abrasion. Whatever your requirements in eliminating or controlling ice bring them to BFG...the leader in De-Icing. For information contact *Dept. MR-10, B.F.Goodrich Aerospace & Defense Products, a division of The B.F.Goodrich Company, Akron, Ohio.*

"HAIL-SAFE" DE-ICING is provided on empennage of General Dynamics/ Convair 880 by BFG Cladheat electro-thermal De-Icers. Stainless steel skin withstands abrasion from rain, dust, even hail at high cruising speeds. Six-foot Cladheat sections are bonded to leading edges to form a smooth, integral airfoil.



LIGHTWEIGHT PNEUMATIC De-Icers equip wing and tail surfaces of light twin engine aircraft.

ELECTRIC PROPELLER De-Icers for light twins feature light weight and low power consumption.



HEATED RUBBER bonds securely to complex curves and odd shapes as well as flat surfaces. Integral electrical heating elements control ice formation in areas such as air intakes and cowls, or provide heating for power units.

B.F.Goodrich

aerospace and defense products

STL/Bell Draco Could Fill Pre-Saturn

An exclusive M/R report on fluorine/hydrogen upper stage being proposed for mating with Titan II

by Frank G. McGuire

LOS ANGELES—A fluorine-hydrogen upper stage being developed for use with *Titan II* may close the increasingly serious gap between *Atlas*-boosted vehicles and the upcoming *Saturn* launches.

The hypergolic propellant mixture would be employed in an upper-stage configuration designed by Space Technology Laboratories, Inc. and powered by an engine from Bell Aerosystems Company.

The upper stage, designated *Draco*, is designed for rapid transition from drawing-board to hardware, and uses a multiple-space-restartable engine closely approximating that used in the *Agena* satellites.

Ignition has been the primary cause of trouble with *Centaur*, and although *Draco* would not be operationally ready for space missions as soon as *Centaur*, the basic design indicates that its hypergolic propellants would vastly reduce ignition problems.

STL says the *Draco* would have over 440 seconds specific impulse and approximately 30,000 lbs. of thrust, and could be launched a little over two years after a go-ahead order. (*Centaur* has 425 seconds of specific impulse and 30,000-lb. thrust level, using two engines.)

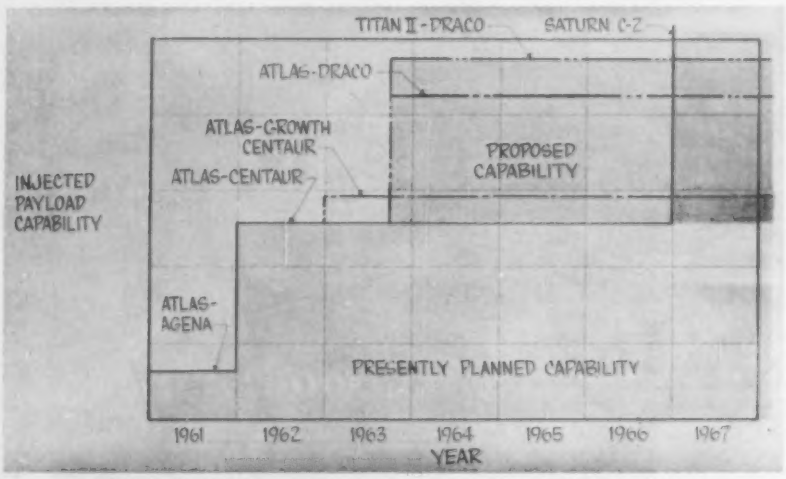
Although no commitment has been made to push *Draco*, the delays currently afflicting *Centaur* (M/R, Sept. 4, p. 12) may force such a decision soon.

The single-engined stage can be used with *Atlas*, *Titan II*, or *Saturn C-2*, but is obviously intended to enhance the potential of *Titan II* as a space booster—something the Air Force has not wanted to talk about.

For use with *Titan II*, *Draco* would be 10 ft. in diameter. It would be approximately 25 ft. long if single bulkheads were used for separating the propellant tanks. If double bulkheads were used, to provide room between the tanks for insulation to make the propellants space-storable, the length would be about 28½ ft.

These dimensions generally vary, depending on the booster to be used and the mission.

A Jet Propulsion Laboratory study conducted to determine the optimum combination of upper-stage liquid propellants for space boosters concluded that fluorine and hydrogen were the best. The independent study, having no connection with *Draco*, generally concurs with all STL statements about *Draco's* advantages and abilities.



LAUNCH VEHICLE capability of Draco for soft lunar landing mission.

The STL/Bell team says it has solved all problems of storage, transfer, materials and operating procedures connected with fluorine/hydrogen, one of the highest energy combinations available in stable chemical systems.

The engine, a pump-fed design, would be manufactured and tested by Bell, and the remaining stage subsystems by STL. The complete propulsion system would be tested at Edwards AFB, Calif. The team points to a record of 600 rocket engine firings in which Bell used fluorine with a variety of fuels.

• **Capabilities**—With a total impulse of 16,500,000 lb./sec., *Draco* used with *Titan II* could put at least 3000 lbs. into 24-hr. equatorial orbit about the same mission established for the *Advent* communication satellite. Present *Advent* configuration reportedly calls for a weight of more than 1250 lbs., which will strain the ability of *Atlas D/Centaur* even if optimum performance is achieved.

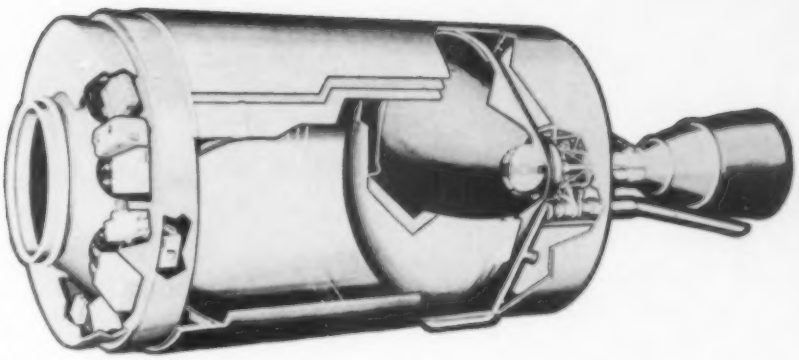
There are similar advantages for most other missions, STL says, and at higher velocity requirements the *Draco* stage can carry half-again to three times the weight of an oxygen-hydrogen stage. There is an added advantage in being able to orbit two or more payloads with one launching.

Although *Saturn* boosters will be available later in this decade, STL points out that some missions will not utilize the maximum potential of these boosters, and that a *Titan II/Draco* booster would be much more economical for a large proportion of missions.

This will go far toward alleviating the payload deficiency expected to become most critical in 1963-1966, when missions beyond *Atlas/Centaur* cannot be planned, according to STL.

• **Vehicle design**—Basically a conventional design, *Draco* uses existing subsystems to a large degree. The greatest departure from current practice is the fluorine propellant. The engine is closely similar, and in some cases identical, to the *Agena* engine. The

Booster Gap



CUTAWAY drawing shows design of Draco.

control and instrumentation subsystems closely resemble those used by STL on the *Able* and *Ablestar* stages. The inertial guidance system could be the same used for *Centaur*.

Guidance of *Draco* can also be accomplished through the STL-developed system used for *Able*—or with a combination of the *Centaur* and *Able* systems. Cabling and programing equipment for start/stop signals to the *Draco* engine, or for steering signals to the autopilot, are compatible with both systems.

Either all-inertial or radio command guidance systems can be used.

Gross weight of the stage is about 40,000 lbs. without payload or fairing. Powered by the single, gimballed, restartable engine, the stage uses a three-axis autopilot to provide attitude commands during powered flight, and a hydrogen peroxide gas jet system during coast periods.

Electrical power supply would come from batteries. Thermal control is maintained by a combination of fixed and jettisonable radiation barriers.

Tandem propellant tanks use a common bulkhead, with the heavier fluorine in the lower tank. Made of welded aluminum alloy, the tanks use internal pressure to stabilize the monocoque cylinder. Baffles are included to prevent propellant sloshing.

Helium pressurization is provided by a completely-immersed sphere in each tank. The pressurization in the hydrogen tank is augmented by gaseous hydrogen passed through a heat exchanger at the turbopump exhaust.

A preset schedule governs propellant tank pressurization, so that required pump inlet pressures and pressure differentials between tanks are maintained.

Telemetry, tracking and command control for *Draco* is similar to that used for *Able* and *AbleStar*. Telemetry consists of a wideband IRIG FM/FM system with 10 subcarriers and a one-watt transmitter.

Electrical power is furnished by a main d-c supply in a silver-zinc battery system. The guidance package obtains a-c power from a static inverter, and the telemetry and range safety systems contain their own battery power.

Ground support equipment and launch site modification have been made as simple as possible to allow maximum use of existing equipment. One segment of the GSE supports the *Draco* propulsion system and the other segment services the electrical system.

Equipment for the latter includes a checkout van, a telemetry van, launch operating equipment and other miscellaneous support arrangements. The propulsion system support system mainly includes facilities for storage, transfer and disposal of fluorine.

Launch complex modifications include installation of a fluorine storage tank, conversion equipment for introducing gaseous fluorine to propellant tanks and lines for conditioning, a vent gas disposal system for handling fluorine vented during stage loading, and a neutralization system using water fog.

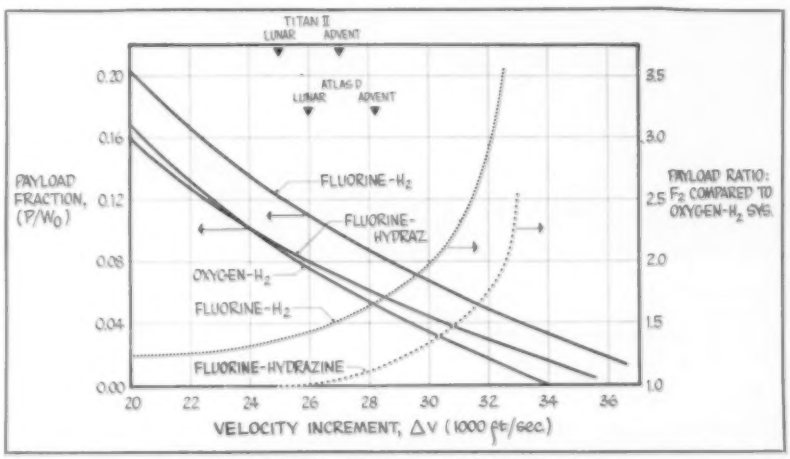
STL/Bell point out that fluorine is now available in large quantities for as little as 90¢ per lb. It is no more toxic than hydrazine, UDMH, or hydrogen peroxide, and is transported by 5000-gal.-capacity tank trucks. It is easily neutralized by water fogs when spilled.

• **Bell engine**—Using experience gained in the *Agena* program, Bell Aerosystems Co. has come up with a predicted reliability for its *Draco* engine of 98.3% by the time of the first launch. *Agena* engine tests, modified to apply to *Draco*, were used as a basis for prediction, due to the design similarity.

The engine is designed to start and stop in a vacuum, and has a three-restart rating during a total in-flight operating time of over nine minutes. Both propellants are supplied to the combustion chamber by a single turbopump driven by a gas generator. The turbopump also supplies thrust-vector-control hydraulic power through a geared hydraulic pump.

The tubular-walled thrust chamber uses the liquid hydrogen as coolant as far as the 22:1 expansion-ratio point, and the remainder of the exhaust skirt is uncooled to its 45:1 point. The uncooled portion is of columbian alloy.

The engine requires only start/stop controls, with all operations internally controlled by pressure switches and one temperature sensor. Fuel and oxidizer valve sequencing permits nearly simultaneous entry of propellants into the combustion chamber, where hypergolic ignition obviates the need for a separate ignition system. ■



COMPARISON of high-energy chemical stages.

NORAD ON THE ALERT

Inputs from BMEWS Provide Instantaneous Missile Data Direct to NORAD Headquarters

From our vast outer defense perimeter, over thousands of miles, to the nerve center of the North American Air Defense Command at Colorado Springs, the most advanced concept of data handling and checkout is being utilized in the BMEWS system. The stakes are high, for the purpose is defense of the North American Continent.

At BMEWS installations operated by USAF Air Defense Command, computers read out missile tracking data from giant radars. This information is simultaneously relayed to NORAD's Combat Operations Center.

The Radio Corporation of America is prime systems contractor for BMEWS. At the COC, RCA's Display Information Processor computing equipment automatically evaluates missile sightings, launch sites and target areas. By means of data processing and projection equipment installed by RCA and a team of other electronics manufacturers, the findings are displayed on huge, two-story high map-screens in coded color symbols, providing the NORAD battle staff with an electronic panorama of the North American and Eurasian land masses.

The handling of BMEWS inputs at NORAD is an example of how RCA data processing capabilities are assuring the high degree of reliability so vital to continental defense.

At NORAD Headquarters, RCA computing equipment, the Display Information Processor (control console shown here) receives sightings data from BMEWS and processes it for automatic readout.

RCA is prime system contractor for the sprawling BMEWS three-site radar network whose probing electronic fingers reach deep into space to provide early warning of missile attacks.

RCA's Automatic Checkout & Monitoring equipment continuously tests and checks performance of portions of the system and alerts an operator when a monitored signal exceeds certain limits.

Out of the defense needs of today a new generation of RCA electronic data processing equipments has been born. For tomorrow's needs RCA offers one of the nation's foremost capabilities in research, design, development and production of data processing equipment for space and missile projects. For information on these and other new RCA scientific developments, write Dept. 434, **Defense Electronic Products,** Radio Corporation of America, Camden, N. J.

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Stratoscope II to Give Clearest Look

Princeton's Schwarzschild, director of balloon telescope project, says it may revise some basic concepts

by William Beller

THE AEROSTAT *Stratoscope II* is scheduled to rise 80,000 feet over Minnesota next summer to open the second phase of a major program of balloon astronomy. This work is expected to develop new basic concepts of the universe.

Stratoscope II could give astronomers a fantastically clear look at the heavens, one whose images would be resolved to within 0.1 second of arc. This is equivalent to being able to distinguish two golf balls 15 inches apart 500 miles away.

From an astronomer's point of view, this betterment in resolution is critical. The best resolution that earth-bound observatories can obtain, limited as they are by the atmosphere above them, is 0.3 seconds of arc.

Professor Martin Schwarzschild, internationally known Princeton University astronomer in charge of the *Stratoscope* project, told MISSILES AND ROCKETS that through such high-resolution balloon telescopy astronomers hope to learn:

—The dynamics of the birth and death of stars.

—Whether there are holes in Venus' cloud cover.

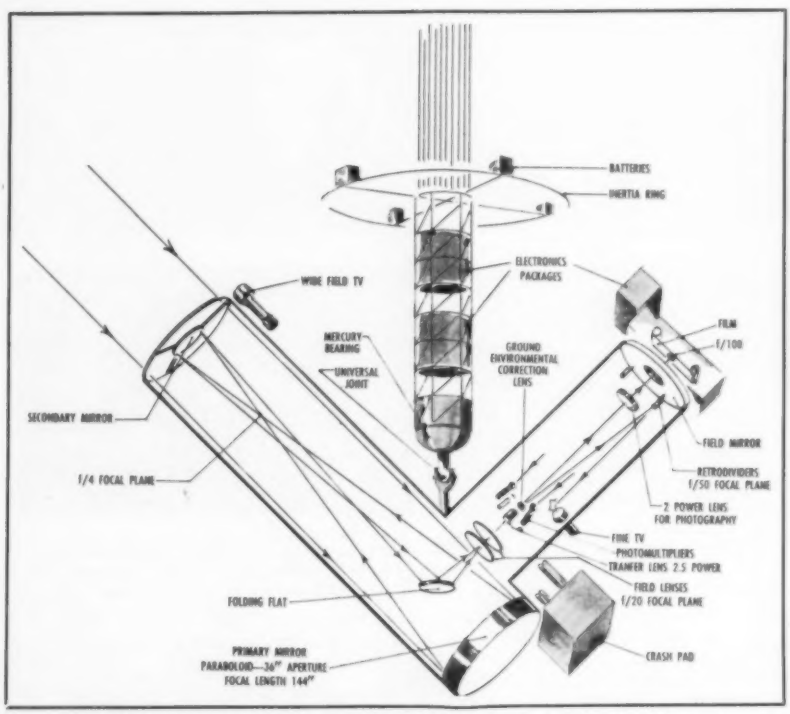
—Whether there are multitudes of small craters on the moon's surface.

—Some of the characteristics of Jupiter's atmosphere.

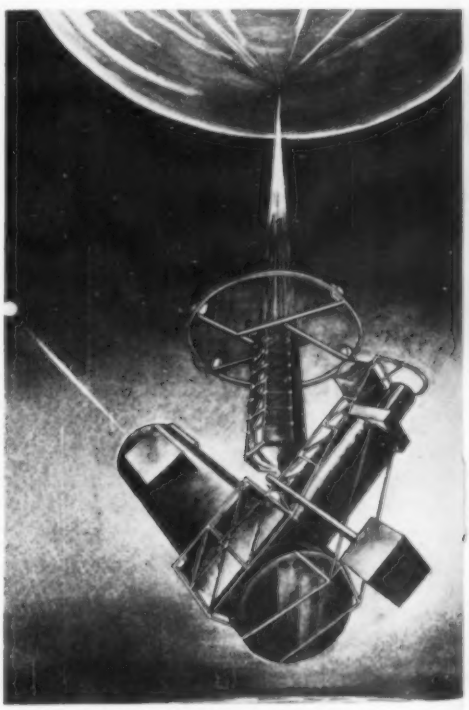
• **Two paths to travel**—*Stratoscope* flights began in 1957 when a General Mills polyethylene balloon lifted a 12-inch-aperture telescope to altitude above New Brighton, Minn. This was the start of Project *Stratoscope I*, which two years later was to yield spectacular photographs of the solar surface.

At first the work was sponsored solely by the Office of Naval Research. In 1959, the National Science Foundation (NSF) and the National Aeronautics and Space Administration became co-

S. KIDD



OPTICAL DIAGRAM of Stratoscope II's 36in.-aperture reflecting telescope



ARTIST'S CONCEPT of telescope.

at Heavens

sponsors, giving the program added impetus.

The telescope on *Stratoscope II* will have a 36-inch aperture, three times the size of the one on *Stratoscope I* and consequently yielding three times the resolution.

It is well known that the measures of a telescope are its resolving power and its light-gathering power. Each is theoretically a function of the telescope's diameter—that is, of the diameter of a reflecting instrument's mirror.

Practically, though, the limit of resolution on earth is reached with a 12-inch telescope. Although a larger one such as the Mount Palomar 200-inch instrument is able to glimpse light from far distance places, it can do no better than the smaller telescope in distinguishing discrete features of heavenly bodies.

The earth's atmosphere not only blurs the images coming into telescopes but also is opaque to ultraviolet light. Therefore, there are two distinct research directions that an astronomer can take once he has an instrument able to rise above a significant part of the atmosphere. He can pursue high definition work as in Project *Stratoscope*, or he can go entirely above the atmosphere and observe the ultraviolet light from the stars. This last direction will be taken when NASA's *Orbiting Astronomical Observatory (OAO)* is launched sometime in 1963.

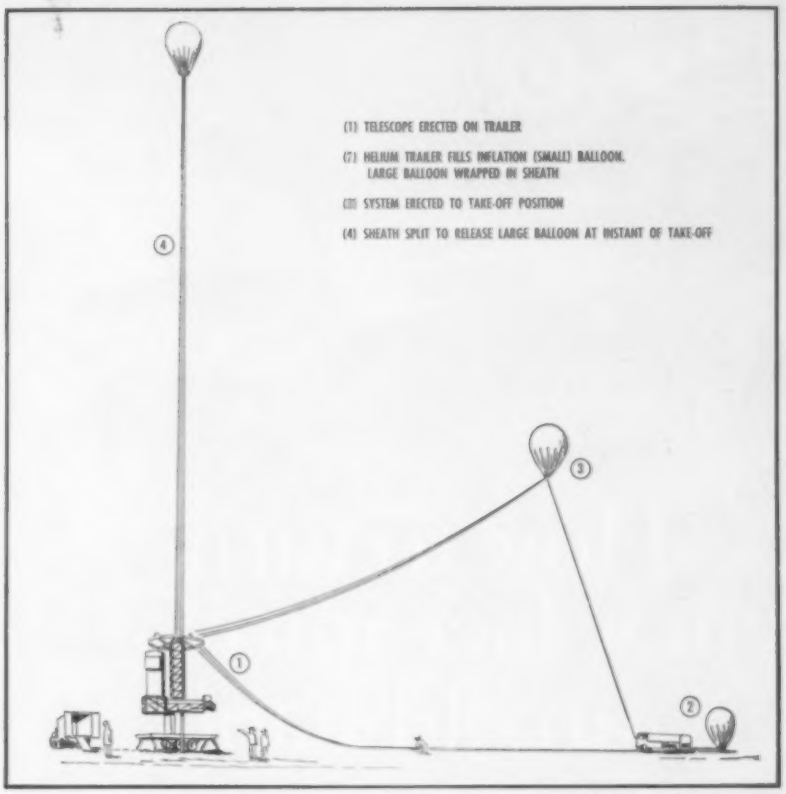
• **How stars are born**—In today's technology, a balloon-suspended telescope has advantages not easily duplicated by a satellite observatory:

—An astronomical body can be studied continuously for a relatively long time—up to an hour.

—Heavy weights can be lifted and they will not have to undergo exceptional stresses during launch. The *Stratoscope II* telescope will weigh over three tons and the total weight to be lifted will be about six tons. (By comparison, the payload of *MA-4*—the unmanned *Mercury* shot of September 13—weighed 2700 lbs. in orbit.)

—The stability of the telescope itself will be within the 0.01 second arc needed to achieve the 0.1 second of arc resolution of the telescopic images.

—A moderate altitude, such as 80,000 feet, is sufficient for astronomical observations by visible light; and the altitude is economically reached.


(1) TELESCOPE ERECTED ON TRAILER
(2) HELIUM TRAILER FILLS INFLATION (SMALL) BALLOON. LARGE BALLOON WRAPPED IN SHEATH
(3) SYSTEM ERECTED TO TAKE-OFF POSITION
(4) SHEATH SPLIT TO RELEASE LARGE BALLOON AT INSTANT OF TAKE-OFF
1
2
3
4

STEPS IN LAUNCHING Stratoscope II. Small balloon is shown inflated, while beneath it the larger balloon is held in a sheath which is ripped off at launch.

Stratoscope II is expected to yield data in several areas.

Astronomers are fairly certain that new stars are being formed in some of the many dense gases or nebulae that lie between stars. The Orion nebula—that famous bright one visible to the naked eye—is the best example, and is also the best nebula for observation.

Understanding of how stars form in such gases is extremely incomplete. Schwarzschild asserts that it is important to know whether these gases are found very evenly and smoothly spread, or whether they are found to be "clumpy"—that is, very dense large clouds imbedded in much less dense gaseous accretions.

The answer to this question is blocked by inability to get sharp pictures from the ground. Yet these dense gas clouds are just on the verge of being resolvable from earth.

The hope is that *Stratoscope II* will get sharp pictures of the brightest and densest portions of the Orion nebula. "We may find that these gases don't look smooth at all but are highly varying," says Schwarzschild. "Thus, very sharp pictures of the very bright portion of the Orion nebula are nearly bound to help us in the theory of the origin of stars."

Astronomers suspect that normal stars die by ejecting a large part of their total mass in gases. This phenomenon is believed to be observed in the so-called "ring nebula." What is not understand is the dynamics of how the star does such ejecting: is a smooth shell of gas throw off or gigantic puffs of gas? Astronomers say the answer would be decisive for theoretical work.

Thus, just as *Stratoscope II* can use the Orion nebula to study the dynamics of the birth of stars. so it can use the ring nebula to study the dynamics of the death of a star.

On several occasions, observers have thought they perceived breaks in the cloud layers enshrouding Venus. These breaks, if they existed, were felt to be 0.2 seconds of arc in magnitude, too small to be perceived with certainty with an earth telescope, but large enough for the *Stratoscope II* telescope to resolve.

If such breaks do exist, then the theory of the atmosphere of Venus predicts strong greenhouse effects and these would verify the recent radio measurements which suggest that the surface of Venus is exceedingly hot.

Furthermore, the breaks might also permit us a peek at Venus' surface.

How to turn a new face into an old hand

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Videosonic systems have proven their merit in 5 years of use in Hughes plants in El Segundo and Fullerton, California and Tucson, Arizona. Today, they assure the reliability and speed production of Polaris missiles, electronic armament systems, Falcon missiles, electronic air defense control systems, and advanced computer systems.

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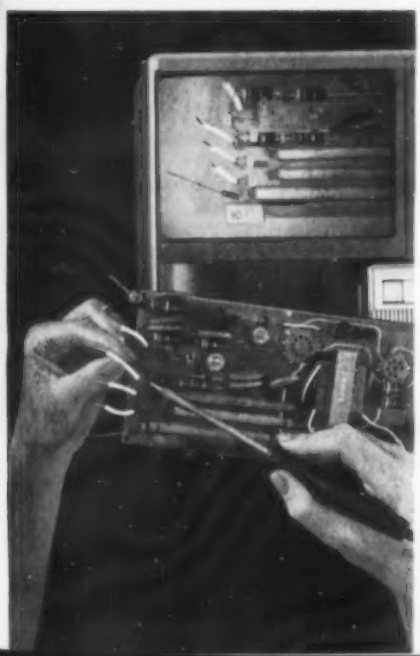

FUSED-SILICA BLANK for Stratoscope II's telescope was cast by Corning Glass, precision-ground by Perkin-Elmer.

Many observers suspect that there may be a multitude of craters a fraction of a mile in diameter existing on the moon. Schwarzschild says that *Stratoscope II* will try to take some sample photographs of the moon; and because of the step upward in picture sharpness, "this exciting question of miniature craters may be answered."

• **Multi-million-dollar telescope**—*Stratoscope II*, which will cost between $3 million and $3.5 million, is being managed for Schwarzschild by Vitro Laboratories, Silver Spring, Md. The company's role is to supervise development of the balloon system, devise the launching and recovery methods, and conduct the launches.

The reflecting telescope, which is estimated to cost about $2.2 million, was designed and developed by the Perkin-Elmer Co., Norwalk, Conn., and is expected to be ready for test late next spring. The instrument is an L-shaped structure, with one arm about 25 feet long and the other nearly 19 feet.

The 36-inch fused-silica optical mirror for the telescope was fabricated by Corning Glass Works, Corning, N.Y. This is the largest fused-quartz blank ever made and, significantly, the most accurately ground mirror ever placed in a large telescope.

Previously, there was no need for high accuracy in a telescope's mirror. One-fifth or one-fourth of a wavelength of green light—which is the middle of the visible spectrum—was sufficiently close to grind the mirror for the resolution the atmosphere permits.

Now, however, the mirror surface has to be a true parabola within 1/20 of the wavelength of green for *Stratoscope II* to get the designed resolution. This means that grinding has to be true within one-millionth of an inch.

Fused silica is used for the mirror, since it is not affected by the sharp temperature gradient the balloon telescope will experience.

• **Piggy-back balloons**—Design of the balloon system involved some tricky problems because of the high order of stability needed by the telescope platform. The scheme now used calls for suspending the gondola on a mercury bearing; in this way, the telescope platform is decoupled from the balloon and motions are not transmitted.

An inertia ring—located above the mercury bearing—can be coupled to the gondola by a magnetic clutch. The ring acts as a brake on gondola motion and can be engaged on command.

The G. T. Schjeldahl Co., Northfield, Minn., which is developing the balloon system, is contemplating a two-balloon launch—one balloon on top of the other. This technique will permit launchings in winds up to 15 knots, in contrast with the usual requirement for a balloon launch of practically no wind.

The topmost balloon, smaller of the two, will be filled with helium for the launch. The lower balloon will be enshrouded in a three-foot tube of Mylar, substantially cutting down the flat plate area. At launch, the tube will rip open, freeing the lower balloon as the aerostat rises. As altitude is reached, the helium will expand into the lower balloon, with most of the gas transfer occurring between 10,000 and 14,000 feet.

The balloon will be made of Mylar plastic reinforced with a dacron mesh. Developed by Schjeldahl for ONR, this material is reported to be lighter and stronger than polyethylene.

While the telescope is at altitude, it will be focused and monitored by a remote-control television system and a 70-station command channel developed by RCA Laboratories in Princeton. This TV system, using RCA's new high-resolution image orthicon tube, will be further developed for the *OAO*.

The Sierra Research Corp., Buffalo, is providing the telemetry.

To avoid damaging the telescope by ground impact, Vitro is considering use of a helicopter to snag the descending balloon system. The first test of such a system is tentatively scheduled for late fall provided an *H-21* type helicopter is available.

For the first flight, the balloon is to remain aloft throughout the night while observations are being made. There is no planned end to the number of subsequent flights. Schwarzschild enthusiastically told M/R: "Once that instrument works the way we hope it will, it's such a magnificent tool—we are certainly going to exploit it! ¤

Fresh Successes Buoy Zeus Backers

Army cites tests at PMR, White Sands and Ascension and reports new capability; AF cooperation is praised

by James Trainor

ALTHOUGH still bogged down in politics, *Nike-Zeus* is achieving its development goals on or ahead of schedule, according to Army officials.

The enthusiasm and optimism of the *Zeus* development team—clearly evident in MISSILE AND ROCKETS' special *Zeus* report (M/R, Jan. 30, p. 26)—has been further enhanced by successful achievement of several major test objectives. These include complete systems tests at White Sands Missile Range, a partially successful firing of the complete missile at the Pacific Missile Range and the acquisition and tracking of ICBM warheads from Ascension Island in the Atlantic.

• **Target track radar works**—On May 27, the *Zeus* TTR at Ascension successfully tracked an *Atlas* ICBM warhead fired from Cape Canaveral. This test, in addition to proving ability of the radar to "lock-on" a target nose cone, provided valuable information to both the Army and the Air Force on the signature characteristics of re-entry bodies.

This data, plus information gathered from DAMP (Downrange Anti-Missile Program), has been used by the Army to test *Zeus* against simulated ICBM's. Tapes from these signature studies have been fed into the Target Intercept Computer (TIC), thus "fooling" both the TIC and the missile into seeing the re-entry body. The reaction of both systems to the simulated threat has been highly satisfactory, according to the Army.

• **Progress at White Sands**—An additional radar site is under construction at White Sands Missile Range. The Army is now checking out the acquisition radar for this second system.

In July, the Canard configuration of *Zeus*—or as the Army prefers to call it, the Forward Fin Control version—was fired from a "tactical" launch pit with live first and second stages. This firing proved out the operational launch procedures as well as missile configuration.

The Army also has conducted tests on the optimum launch cell for *Zeus*. The missile has been launched from its underground cell, first with the cell vents open to dispel the blast and exhaust gases, then with the cell completely blocked. The test results proved the worth of the vented cell.

The TIC at White Sands is in place and is being used in test firings—together with other *Zeus* ground support equipment—to control the missile. The Army has also tested a new second stage for the missile which provides a substantial improvement in performance over the o'd propellant. The new stage is produced by Thiokol's Redstone Division.

• **Pt. Mugu firing program**—On Sept. 9, the first full-scale test of the *Zeus* system was conducted at Pt. Mugu. However, after approximately 20 seconds of flight, the three-stage missile exploded. The failure is attributed to a range safety device which will not be on tactical missiles or missiles launched from Kwajalein.

The test program at PMR has been kept purposely spartan, with only two firing pits and a battery control center. This is in keeping with the Army's philosophy of using the Pacific test site only for those high-altitude, long-range tests that cannot, due to range limitations, be conducted at White Sands.

The latter location, they explain, will be the major R&D test site. Difficulties encountered at PMR and Kwajalein will be corrected and tested at WSMR, because of the tremendous resources in men and facilities already invested in the desert test site.

• **Kwajalein work proceeds**—The brick and mortar construction at the Kwajalein test site is approximately 70% completed, and much of the mechanical checkout of the facilities has been finished. However, work is still being done on the electrical checkout. This work, the Army stresses, is either on schedule or ahead of schedule and should be completed prior to the critical firings against operational ICBM's slated for next year.

In connection with these firings, the Army points out that considerable progress has been made in the field of warhead discrimination. The TIC, they note, is the critical element, since it is responsible for data processing to pick out the target. An improvement in this area improves the discrimination capability of *Zeus*.

• **AF cooperation cited**—One of the chief concerns of people responsible for the *Zeus* development program is the tendency of the press, in particular, to build up the coming Kwajalein tests as a contest between the Air Force and the Army. Nothing could be further from the truth, they say.

The cooperation that the Army has had from the Air Force, they stress, at every opportunity, has been outstanding and could not be more gratifying.

• **Non-technical developments** — Even though the ability of *Zeus* to intercept and "kill" enemy ICBM's is still being questioned, the Army's Director of Special Weapons, OCRD, Brig. Gen. David C. Lewis, confirmed a still greater extension of *Zeus* capability.

Speaking before a conference sponsored by the National Rocket Club in March, the general reported that minor changes in the system could extend the range of *Zeus* to 200 miles; major changes would yield 1200 miles in vertical range. This would make the system capable of destroying low-orbiting earth satellites as well as missiles.

The Kennedy Administration has continued the policy of withholding preproduction engineering funds from the *Zeus* program. Not even the buildup in military capability, the resumption of nuclear tests and the Berlin crisis have altered this decision. Nor do Army officials expect that the White House will reverse itself. However, they do point out that the pre-production funds have not been officially linked to the success of the Kwajalein tests; therefore, a decision could be made at any time.

In any case, nothing has dimmed the faith of the Army in the ability of *Nike-Zeus* to provide an effective antimissile defense. With the program achieving the technical milestones set for it, Army confidence is high that *Zeus* will eventually prove itself—to everyone's satisfaction. ⌘

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NASA Opens Drive to Recruit 4000

THE BIG BUILDUP is beginning at NASA.

The space agency starts a recruiting campaign this month to add some 4000 employees by June 30 of next year. These will include 2000 scientists and engineers for the *Apollo* and scientific satellite programs.

Approval of a supplementary appropriation bill in the last moments before the Congressional session ended cleared the way for NASA to transfer $10 million from its research and development budget to salaries for new employees.

The agency has already authorized recruitment of some 3000 employees under funding included in NASA's Fiscal '62 budget. Permission to switch the $10 million gives back to the agency about half of a $20-million cut in salaries and expenses slashed from the budget earlier by Congress.

NASA originally asked Congress for authority to hire 4900 new personnel in Fiscal '62. The new funds mean the space agency has money for about 4400 of these, with approximately 400 jobs already promised to applicants.

If all the new jobs are filled, NASA's total employment will rise to 21,400. Approximately 700 of the new jobs will be at NASA headquarters in Washington.

As the recruiting drive gets under way, NASA recruiting offices will be set up in New York, Los Angeles and Dallas. A major effort to attract new employees also will be made at next week's meeting of the American Rocket Society in New York.

At the same time, advertisements will be run in leading newspapers and trade magazines. Other NASA recruiters will visit cities across the country and scout technical and professional meetings and leading educational institutions.

Approximately 45% of the new positions will require scientific or engineering backgrounds. With a turnover rate of some 7% this means that about 2000 such jobs are open. Remainder of the new positions are administrative, support and trade personnel.

NASA Personnel Director Robert J. Lacklen expects no difficulty in filling those jobs.

This will not be true, he asserts, in the engineering and scientific area, where NASA is faced with two major problems:

NASA Estimate of Government & Industry Salaries for Engineers & Scientists

Civil Service Salary Grade	Government Rate	Industry Rate
5	5,335	6,350
7	6,345	7,400
9	6,435	8,500
11	7,560	9,800
12	8,955	11,600
13	10,635	14,200
14	12,210	15,600
15	13,730	18,500
16	15,255	23,000
17	16,530	35,000
18	18,500	38,000

(1) The inability to compete with the top salaries offered by industry.

(2) Lack of opportunity to tap the 1962 graduating classes at technical educational institutions until sometime in Fiscal 1963.

While government salaries compare favorably in the beginning Civil Service grades, the spread widens until top government personnel are making less than half what industry is paying for comparable jobs (see chart).

• **Possible improvement**—One partial solution to the problem may be forthcoming in the near future. NASA and other government agencies have asked the Civil Service Commission to approve a policy change which would enable them to pay all scientific and engineering employees at the top rate permitted by the various Civil Service grades. Thus, such employees would not have to work through perhaps three small pay raises within the GS-9 pay scale. Instead, when considered ready for promotion, they would immediately jump to the pay scale in the next grade.

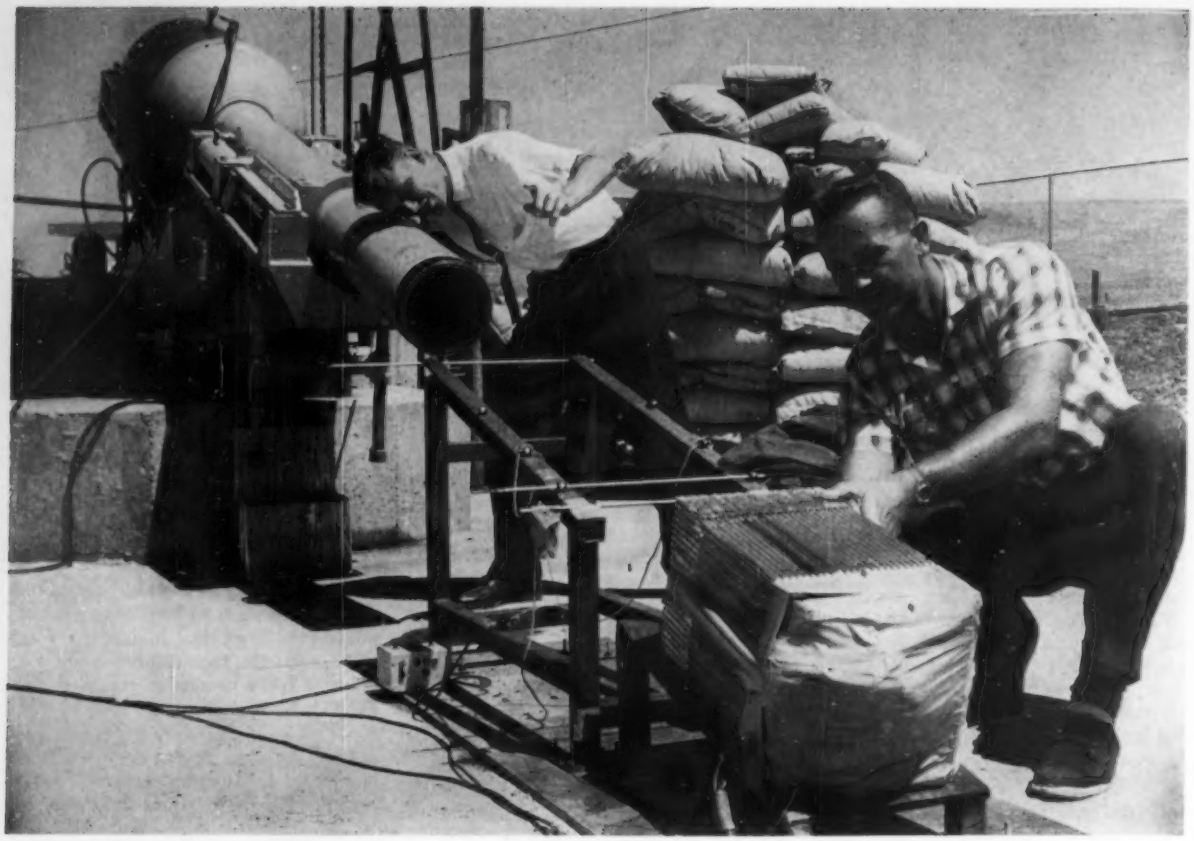
Space agency officials also are counting on patriotism to help overcome the salary gap. They feel many Americans will forego the high salaries offered by industry for a chance to play a part in the U.S. space effort.

NASA officials point out that almost anyone with a degree in a physical science or engineering can expect to be qualified for some job at NASA.

For instance, among major areas included in the 2000 new positions are fluid and flight mechanics, materials and structures, data systems, propulsion and power, flight systems, instrumentation systems, measurement, experimental facilities, space sciences, life sciences, and project management. ⌘

Off-Loading Blue Steel

METHOD OF TRANSFERRING A. V. Roe & Co. Ltd.'s Blue Steel air-to-surface missile from transporter vehicle to aircraft loading trolley was shown at Farnborough Show. The V-bomber nuclear stand-off weapon system is the only one in U.K. arsenal.



electronics

Litton Tape Recorder Survives Impacts

Sandia tests using unusual air gun indicate unit made by Westrex Div. can live through flights on warheads

by Charles D. LaFond

BEVERLY HILLS, CALIF.—A new miniature tape recorder, used to collect data during flight tests of experimental missile warheads, has survived impacts up to 1500-g without losing previously recorded data.

Tests recently completed by Sandia Corp. at Livermore, Calif., using a high-velocity air gun, also have shown the recorders capable of continued data recording while undergoing 750-g shocks sustained for 5 milliseconds.

Developed here by Westrex Recording Equipment Division of Litton Systems, Inc., the 5-lb. cylindrical units were built to withstand all the conditions experienced by missile warheads. These, designers say, include all the high-g loadings encountered in high-velocity water impacts, ground impacts and launch accelerations.

To assist in its studies, Sandia scientists have been searching for a recoverable recorder with just these characteristics so that design evaluation of weapon systems during flight can be made. Results of its recent tests indicate that the Westrex recorder has met all performance requirements.

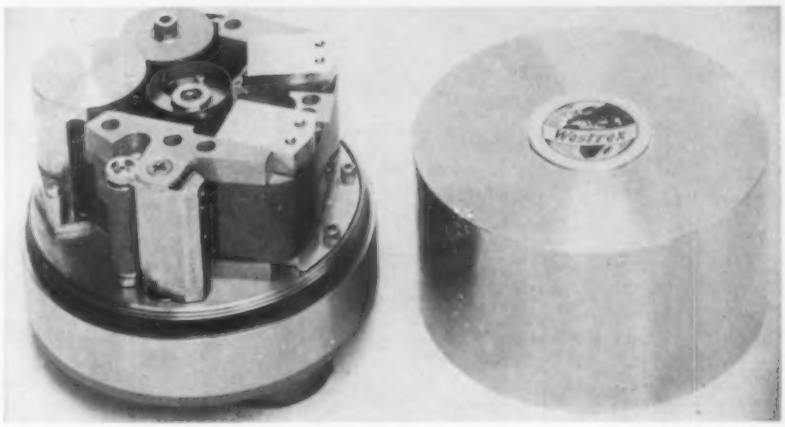
Sandia, a prime contractor to the Atomic Energy Commission, is currently engaged in R&D of ordnance phases of the nuclear weapons program.

• **Air gun cuts costs**—The 8-inch air gun developed by Sandia is one of the few test devices of its kind in existence today. Capable of reproducing launch and impact g-environments under many laboratory conditions, its use permits evaluation tests which otherwise could only be obtained through time-consuming, costly missile flights.

During the tests, Sandia engineers installed the tiny tape units in a special four-recorder jig. The jig formed a part of an aluminum honeycomb "target" at which the air gun was aimed to produce controlled, sustained high-g loads.

RECORDERS ARE MOUNTED in special jig for air-gun warhead-impact testing. These units, under simulated flight conditions, survived 1500-g shocks without loss of recorded data during recent tests at Sandia's Livermore Laboratory.

EIGHT-INCH air gun, one of few test devices of its kind in existence, is used by Sandia Corp. to simulate high-g loads present during a missile flight. New missile-borne tape recorders, developed by Westrex, are mounted in the aluminum honeycomb "target." Information has been recorded through impact shocks of 750-g, sustained for 5 milliseconds.



MINIATURE 5-LB. recorder carries 500-ft. reel of 1-in., 1-mil thick, Mylar tape providing 14 data tracks. Transport speed is 15 in. per second.

cts of 1500 g and Retains Recorded Data

During the tests, information was recorded through impact shocks of up to 750-g, sustained for 5 msec. No damage was experienced by the recorders, says Sandia. In subsequent tests, the devices survived 1500-g shocks for 3 msec. without loss of recorded data.

• **Recorder details**—Westrex' recorder, designated type RA-1653, actually was designed to operate through a 500-g 11-millisecond square-wave shock and survive a 1500-g impact.

Hermetically sealed, its can-shaped case measures 3-in. x 4-in. dia. It carries approximately a 500-in. long reel of 1-in. wide, 1-mil base Milar magnetic tape.

The present system is designed for 24-volt dc operation (at 25 watts) with a transport speed of 15 ips.

The 1-in. tape allows 14 in-line record or record/reproduce channels. A staggered array of two 7-track recording heads can be used, says Westrex, if cross-talk requirements demand their need. Recording speed also may be altered if necessary.

Cross-talk is better than 50 db below signal level for staggered 7-track leads and 40 db for a single in-line 14 track head.

Gap-scatter, designers say, is a maxmum of ±50 microinches per head.

Choice of recording conditions or method is determined by the required frequency response and other performance requirements.

For carrier-erase recording (using a 1500 cps carrier) a frequency response up to 2 kc is available; for direct recording, response range is from 100 cps —100 kc.

In the transport mechanism, head-to-tape contact is maintained by a tape support and tension control over the full tape path. The design, according to Westrex, also minimizes wow and flutter measurements to within 1 percent rms since tape-path resonance is considerably reduced. In the range of 6-250 cps, flutter is approximately 0.7 percent maximum.

Recorder starting time is 20 msec.

Design operating range of the data recorders is from at least −65° to 165°F. Below 3 kc, says Westrex, there is no significant vibration effect on recorder performance. Natural resonance frequency of the unit is 5 kc.

In addition to the already related test results obtained by Sandia, Westrex engineers say they have tested and operated the units successfully at loads up to 1250-g with a 5-msec. square-wave shock.

With the use of head pressure pads, the company believes the recorders will be suitable for recording applications through shock levels well above those already attempted.

Toward this end, R&D will be continued by the company. ¤

ACTION!

Major advances, coming in increasingly rapid succession from the leaders of the solid rocket propulsion industry, give dramatic evidence of the quickening pace of this nation's big booster effort.

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Test Lab Exploits Automation

AUTOMATION of mechanical steps in environmental testing is giving laboratories a new set of tools with which to handle the fast-growing complexity of satellite and missile components.

At the Wayne, N.J., headquarters of Associated Testing Laboratories, Inc., a large test batch of batteries used in *S-3* and other satellites to send telemetered information to tracking stations was recently put through the automated procedure.

The limits of the tests were programed into the testing equipment by means of a punched tape, capable of lasting the equivalent of 100 days of testing. On command, the equipment can select a component for testing and run it through the procedure—in the case of the batteries, putting preset power drains on them at preset intervals.

Afterward, the testing equipment evaluates the component's performance in terms of the test limits. Part of the circuit includes an electric typewriter, which prints the performance record—along with the time of day, the component's code number, and its passing or failure. A continuous strip-chart recorder is also connected from time to time.

The equipment can make such decisions as whether or not to stop the test if the battery does not meet specifications. The shut-off is announced by typing on the tape or data sheet or by sounding a buzzer.

The human element enters the course of the test only when a technician or engineer inserts a data sheet or tape, dates portions at the beginning of each day's testing, and removes it afterward. The record can be bound directly into the report of the test, or filed away for reference.

Analysis of the results puts the procedure again into the hands of the machine. There is, however, a gap still subject to human error: the transcription and feeding of the results into the computers.

At Associated this will be bridged, according to present proposals, by substituting punched cards for the data tapes and sheets. The cards can then be fed directly into the computers.

• **Advantages**—The benefits of automated testing are numerous. It eliminates human error both in the testing itself and in the observation and recording of test results. In terms of rapidity in testing, it can out-perform a human technician; battery test readings can be made at 50 per minute or more.

Moreover, a large number of batteries, or similar classes of components, can be life-tested simultaneously, without using additional equipment. The equipment can be programed to switch from one battery to another in a fast pattern to make a continuous periodic sample.

Furthermore the equipment can simultaneously record the effect on components of a number of simulated environmental factors.

Companies supplying components for the testing systems of Associated Testing Laboratories, Inc. include: International Business Machine Corp. and Friden, Inc., automatic typewriters; Cubic Corp., digital voltmeters and ohmmeters, and scanner systems; Hewlett-Packard Co., printers, digital clocks; Kin Tel Div., Cohu Electronics, Inc., scanner systems; and Non-Linear Systems, Inc., digital voltmeters. ⌘

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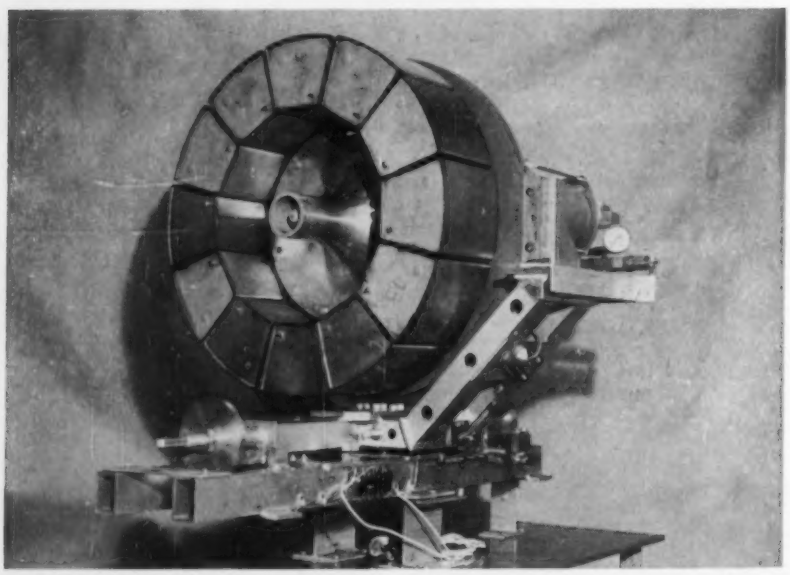
Republic Plasma Pinch Engine to Fly

Company says lightweight XE-1A will operate in space indefinitely and has bigger thrust potential than R&D rivals

IN ENVIRONMENTAL CHAMBER, technician adjusts XE-1A plasma pinch engine described as "first operating self-contained electrical propulsion package."



PREDECESSOR OF XE-1A—the XE-1—mounted on stand designed for accurate measurements of wide range of thrusts. Note XE-1's 12-element capacitor bank.

REPUBLIC AVIATION CORP. reports its plasma pinch engine will be ready for flight evaluation in space early next year. Powered by batteries and solar cells, the engine is said to be capable of indefinite operation in a space environment.

This was disclosed last week when Republic unveiled its XE-1A electrical space engine.

The lightweight engine—which gets its thrust by magnetic pinching of an inert gas such as nitrogen—was described by company scientist Alfred E. Kunen as "the only electrical engine in existence capable of operating today just as it will in actual use on spaceships and satellites."

Kunen says that the XE-1A has already been tested satisfactorily at the Propulsion Laboratory of the Aeronautical Systems Div. at Wright Field. He affirms that "During these tests, direct thrust measurements were taken which indicate a greater thrust potential than that of any other electrical space propulsion system under development."

Republic declined to say whether there were any commitments to put the engine in a satellite next year. But company spokesmen noted that a plasma engine such as the XE-1A has important space missions. Kunen called it the ideal acceleration system for:

—Maintaining spin rates in satellites that are spin-stabilized.

—Changing a satellite's orbital path.

—Maintaining a satellite in a low-altitude orbit by offsetting the effects of atmospheric drag.

—Maintaining a satellite in a 24-hour orbit to perform delicate functions such as rendezvous or docking with larger space stations.

—Preserving the relative positions of a host of satellites performing a single mission.

The present engine weighs 150 lbs., is about 20 in. long and 24 in. in diameter including the capacitor bank.

• **How it works**—In principle, the

y in Early '62

pinch engine consists of a nonconducting cylinder filled with gas and with disc electrodes at each end. When a potential is applied between these electrodes, a discharge in the form of a current sheath travels through the gas adjacent to the inside walls of the cylinder.

The magnetic field created by the flow of the current forces the current sheath radially inward, compressing and heating the fluid within the cylinder. If there is a hole or nozzle at the end of the cylinder, this pinching effect expels the gas, thereby producing a propulsive force. If the fluid within the cylinder is combustible, the pinch will detonate the fluid, thus adding chemical energy to the expellant.

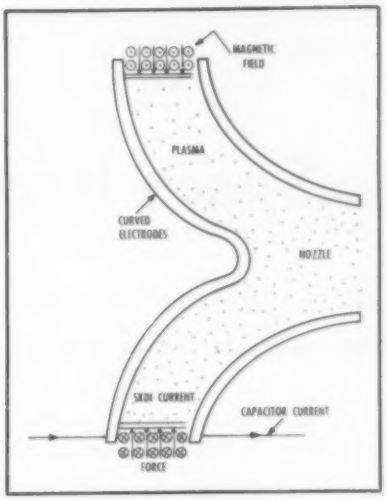
Specific details of the XE-1A were not given, but it is known to be similar to its predecessor, the XE-1.

The XE-1 engine includes all the components needed for self-sufficient operations except the power supply. It consists of radially-dominant-electrode nozzles (the disc electrodes shaped to form nozzles), and an electrical system of 12 capacitors rated at 3000 volts, 10 microfarads each. The thrust of the XE-1 is of the order of 0.01 lbs. The range of specific impulse is between 1000 and 7000 seconds.

The follow-on engine in Republic's development program, the XE-1A, went to Wright Field this March for testing. It is a completely self-contained engine, including its own integral battery power supply delivering 1-kw of energy.

Thrust and impulse levels of the XE-1A are said to be similar to the XE-1.

The Air Force Office of Scientific Research—one of the backers of Republic's plasma work—cites the engine as an instance where hardware development arose directly out of basic research studies. OSR observes that "Although many fundamental problems remain before electro-gas-discharge phenomena are fully understood, the satisfactory use of the phenomena as a propulsion concept appears clearly indicated."



CROSS-SECTION of curved electrodes during pinch exerted by magnetic field.

• **Advantages cited**—Compared with other forms of electrical propulsion, the plasma pinch engine is said to hold the following advantages:

—Large thrust for specific impulse required.

—Broad range of exhaust velocity (specific impulse) in the required range for most missions.

—Stop/start capability.

—Variable specific impulse during operation.

—Variable thrust performance during operation.

—Simplicity.

—Inherent reliability.

In proposing varied uses of their engine, Republic engineers say that the plasma engine will provide an effective propulsion system which can be coupled with guidance instruments to correct errors in satellite orbits. For example, they say, satellites could be placed in an orbit so precise that their position could easily be predicted with accuracy years in advance. "And should the need arise, a satellite could be transferred from one orbit to another, thus obviating the need for additional launchings."

The plasma engine, because of its light weight, could also be installed in a satellite to prevent tumbling, a tendency that interferes with the ability to send and receive messages and to take pictures.

• **In the beginning** — Republic's Plasma Propulsion Laboratory was organized in 1957 to conduct research in plasma physics. It was initially funded by the company; subsequently, contracts came in from the Air Force Office of Scientific Research, the Office of Naval Research, and the Aeronautical Systems Div., Wright Field. The Wright Field contract called for developing a laboratory operational model of a pinch-pulsed plasma engine. This contract led the way from the research engine to today's XE-1A.

Here is the way the work progressed:

1958—At a seminar meeting at Stanford University, Kunen showed the feasibility of developing a propulsion system using the pinch-pulse effect to accelerate plasma in an electrical propulsion system. By August, Kunen and his staff at Republic had built a working laboratory breadboard model of a plasma pinch engine.

1959—Proof of the principle for this engine was successfully demonstrated. A laboratory model was built.

1960—Engine Model XE-1 was assembled, built and tested. Preliminary tests showed average thrust values near 0.01 lbs.

1961—XE-1 was demonstrated at Wright Field laboratories early in the year.

March, 1961—Model XE-1A was assembled, built and shipped to Wright Field for testing. It was successfully demonstrated in the Electrical Propulsion Laboratory environmental chamber.

September, 1961 — XE-1A engine revealed to the public. ■

First Ion Engine Showing

THE FIRST experimental ion engine ever publicly shown in operation was revealed by Hughes Aircraft Co. last week. Developed under a National Aeronautics and Space Administration contract, the engine develops less than 0.1-pound of thrust. Plans call for space-testing an advanced version by late 1962.

Here is how the engine works: Cesium, an easily ionized element, is stored in a reservoir out of which the element's vapor is diffused. The vapor then passes through a hot tungsten element where the cesium is ionized. Next, a system of electrodes apply a voltage to the ions in order to accelerate them to high exhaust velocity. Finally, the high-velocity ion beam runs through a region where electrons are injected to neutralize the positive cesium ions.

Through beam neutralizing, an effective thrust can be generated because there is no relative charge between the space vehicle and its expellant.

Many Missile/Space Issues Deferred

Next Congress will try to shape legislation on indemnification, renegotiation, patents, other matters

by Charles Schaeffer

CONGRESS, adjourning last week after the longest first session in 10 years, left behind a number of unresolved issues affecting the missile/space industry.

Since the session beginning next January is a continuation of the 87th Congress, all unfinished bills and work carry over. Here's the situation on the major bills still pending:

• NASA Indemnification—A carryover from the previous Administration, the proposal is to give the space agency authority to indemnify contractors against "unusually hazardous" risks. Senators were ready to accept the legislation after inducing NASA to limit government liability to $500,000,000 for any one disaster, provided the contractor has maximum commercial insurance available.

Members of the House Space Committee quarreled with the idea of imposing federal tort limitations on the separate states; they pushed a bill minus the limitation through the House. This was pigeonholed by Senators and remains to be resolved next year, if at all.

• Patents—Opposing factions, one favoring tighter, the other more liberal, government patent provisions continued throughout the session to war openly and behind the scenes. Complicating the issue, NASA did an about-face and said it could get along this year without a liberalization giving it more power to waive claim to the titles of inventions developed under space agency contracts. There were assurances that the Administration was developing an overall policy on government patents, but as Congress adjourned those close to the subject on Capitol Hill could perceive no hint of its imminence.

Meanwhile, Sen. Russell Long (D-La.), head of a Senate monopoly subcommittee, remained in favor of a bill to create a new federal agency to preserve the rights of the government to all inventions developed with federal funds. Rep. Emilio Q. Daddario (D-Conn.) continued to develop a record for action on NASA's patent policy next year.

• Renegotiation—An important industry issue facing the next session is whether to modify the Renegotiation Act. The Board recently revised its procedural rules in anticipation of a new attempt to soften the act. These paper reforms probably will help the Board's argument against modification of the law itself.

To some congressional critics, however, the new rules represent no substantial concessions. The Joint Committee on Internal Revenue and Taxation has completed a report documenting complaints against the administration of the Renegotiation Act, but its final recommendations—due in January—are still in the fluid stage. Opposition to modification on the part of the influential chairman of the House Armed Services Committee, Rep. Carl Vinson (D-Ga.), remains undiminished.

• Negotiated Procurement—A bill by Sen. John Sparkman (D-Ala.), to give the General Accounting Office authority to review in advance negotiated procurements, went nowhere. But the Department of Defense reported to Congress it was revising its procurement rules in line with recommendations by the House and Senate Armed Services Committees. One of these would authorize a procurement officer to reduce target costs where he can reasonably show the price was based on inaccurate or out-of-date cost data.

The essence of Congressional objections to the Pentagon's heavy reliance on negotiated procurement was to be distilled in the regulation changes. Although Senators were mostly inclined to accept DOD assurances, Chairman F. Edward Hébert (D-La.) of the House Armed Services Investigations Subcommittee said the policy of advertised bidding should be enacted into law. His proposed bill still is pending.

A lengthy probe of sole-source negotiated procurement disclosed laxness; investigators have joined GAO in demanding that safeguards be written into the rules permitting sole-source buying.

• Identical bids—The House-passed bill requiring contractors to file affidavits that they did not collude in their bids still was pigeonholed in the Senate.

• Missile strikes—Sen. John McClellan (D-Ark.), disenchanted with violations of labor's no-strike pledge to the Administration, proposed legislation to outlaw work stoppages at defense sites. Introduced in the waning days of the session, it was not considered.

• Local taxes—A bill by Rep. A. S. Herlong (D-Fla.) to make defense and other government contractors liable for state and local taxes was not enacted, but can be brought up again.

• Space Communications — Hearings before the Senate Small Business Monopoly Subcommittee on a space communications system, set for Oct. 17, have been postponed until November. A committee of 10 international common carriers is to submit its recommendations to the FCC before Oct. 13; the 15 days following that are set aside for submission of views by interested parties.

Half a dozen committees and subcommittees jumped on the FCC proposal to let American Telephone & Telegraph head a development study.

• NASA vehicles—Chairman Robert S. Kerr (D-Okla.) of the Senate Space Committee indefinitely postponed public hearings set for last week on NASA's *Saturn* and *Centaur* vehicle programs. He said a new date for the hearings would be announced later.

• Central Procurement—Action is pending on a GAO recommendation to Congress that DOD set up a central procurement agency to handle all common supply items, including certain weapons and spare parts.

Earlier, Defense Secretary Robert S. McNamara announced establishment of a single Defense Supply Agency. Its procurement activities are limited, but they may later take in missile spare parts and electronic equipment. ⌗

A.T.&T. Chief Denies Plans To Control Communications

"WE HAVE ALREADY made plain that we have no intention of getting into the space hardware business, even if that were possible."

That statement was made by American Telephone and Telegraph board chairman Frederick T. Kappel in Boston last week in answer to charges that A.T.&T. plans to monopolize the space communications business.

Space hardware, he added, is the business of missile/space industry firms and most of the money required for a satellite communication system will be paid to them for their products and services.

"We are only concerned to make sure that what we spend our money for will provide high-quality, reliable service," Kappel said.

He denounced as "sheer imagination" the suggestion that A.T.&T. is out to dominate and control space communications.

"This must be a world-wide system to be of greatest use, and the rest of the world will likely own more of it than is owned in the United States," the board chairman stated.

He said that A.T.&T. proposals are completely consistent with President Kennedy's policy statement of last July favoring private ownership under regulation. Kappel pointed out that the statement established stringent conditions for equitable sharing of the satellite system and effective competition in the manufacture and supply of its equipment.

"The Federal Communications Commission has full regulatory authority to enforce these conditions and has made perfectly clear that it intends to do so," Kappel said.

His remarks came as President Kennedy, speaking at the United Nations, renewed his proposal for a "global system of communications satellites linking the whole world in telegraph, telephone, radio and television."

Kappel pointed out that A.T.&T. signed a contract last July with NASA under which the company will provide satellites and NASA the rockets for experimental launchings next year.

"In building the ground station at Rumford, Maine, that will be used in testing the experimental satellites," he said, "we have already enlisted the help of 97 contractors and subcontractors. When this station goes to work next spring, it will contain certain basic electronic gear, such as the ruby maser, provided by Bell Laboratories which developed and designed it. The greater part of the entire installation, however, is being supplied by others, although built to our specifications and under our supervision."

Kappel said proposals envisioning government ownership of satellite communication systems are "short-sighted" and a departure from American tradition.

• **On '56 settlement**—He noted that Rep. Emanuel Celler (D-N.Y.) and Rep. James Roosevelt (D-Calif.) had raised the question of violation of antitrust laws by A.T.&T., including the assertion that the firm had negotiated a consent settlement with the Department of Justice in 1956 rather than defend itself against charges of wrongdoing.

In reply, Kappel said: "I fully shared the confidence of our lawyers that if the suit were brought to trial, we and not the Department of Justice, would win it. But we weighed the cost. We weighed the energy that would have to be expended. We knew the need to concentrate attention on the tremendous service job we had to do. We concluded that in order to put ourselves back to work and get on with our job, we would recommend acceptance of the very considerable restrictions that the Justice Department insisted on imposing as part of a consent decree." ¤

Bill Aimed at Giving More Contracts to Small Firms

REGULATIONS to steer more contracts and subcontracts to small business will be drafted by the Defense Department and General Services Administration under a bill passed by Congress.

The bill (HR 8762) gives DOD and GSA chief authority to set up new measures, but requires that the Small Business Administration concur in them. If the SBA rejected a proposed regulation, the final decision would be up to the White House.

One section of the bill is aimed at having DOD, GSA and SBA cooperatively develop a small business subcontracting program. It is designed to insure that small concerns are considered fairly as subcontractors and suppliers in prime contract awards over $1 million and on subcontracts of $500,000.

Prime and subcontract award holders could be asked—through the procurement agencies—to consult with SBA officials about subcontracting opportunities.

Meanwhile, The Martin Co. says it expects to raise its purchases from small business this year by about 28% over last year, and General Electric says it spent 21% of all its defense dollars with small business during the first half of 1961.

Martin spent $106,393,000 with small concerns in Fiscal 1961 and $88,864,000 in Fiscal 1960. The company says about 32% of the total spent in the first half of this year went to small business.

GE says 40,000 firms shared in the company's major defense projects during the first six months of this year, and small firms received almost half of its $1.5 billion expenditure on defense and non-defense procurement. ¤

Financial Reports

COMPANY	PERIOD	INCOME		EARNINGS	
		1961	1960	1961	1960
Airpax Electronics, Inc.	6 Mo. June 30	$ 2,393,107	$ 2,029,902	$ 26,004	$ —
American Marietta Co.	9 Mo. Aug. 31	268,483,257	268,069,005	15,462,450	17,202,260
Avco Corp.	9 Mo. Aug. 31	233,558,320	240,016,634	8,797,648	7,318,365
Collins Radio Co.	Year, July 31	215,000,000	190,566,387	3,075,000	6,532,669
International Rectifier Corp.	Year, June 30	14,512,000	13,124,586	1,080,000	1,206,000
New Hampshire Ball Bearings, Inc.	Year, June 30	8,314,834	7,140,177	689,226	588,944
Rixon Electronics, Inc.	Year, Apr. 30	1,847,016	1,090,396	64,541	62,004
Ryan Aeronautical Co.	9 Mo. July 31	67,848,487	86,073,812	2,176,159	1,772,647
Westinghouse Electric Corp.	6 Mo. June 30	920,381,000	953,844,000	19,561,000	40,454,000

soviet affairs

by Dr. Albert Parry

Soviet-manned rockets in East Germany

are not the only such weapons in that country. In addition to a fairly sizable number of these, missiles have been issued by the Russians to East German troops under East German command.

This information was given to me by a high source in the United States headquarters in West Berlin during my recent visit to the beleaguered city. Soviet Russian units of the occupational forces apparently are in charge of long-range missiles while East German troops are in possession of medium-range and tactical missiles.

"But can the Soviets really trust their East German officers and soldiers with those precious rockets?" I asked my informant in West Berlin. "Would such Germans, in case of a showdown, indeed remain loyal to their Russian Communist bosses?" The source replied: "We must remember that before the Second World War there was a strong Communist Party in Germany. Neither Hitler nor time succeeded in destroying it completely. Many of its stalwarts either stayed in East Germany where the war's end found them or have moved there since the war from West Germany. Their sons are now the smug and dangerous elite ordering the populace around for Khrushchev and Ulbricht.

"These young men, and some who are not so young, are in the top positions of the East German governmental and Party apparatus. They are also commanders of the East German troops, including the new rocket units. They are the Kremlin's praetorian guard in East Germany, as yet completely loyal to Khrushchev. Yes, that Red German elite love their power and privileges and mean to keep them. Khrushchev can depend on these men, on their use of the weapons he has given them."

In Vienna, at a conference of atomic scientists,

I congratulated one of the two Soviet physicists present on Gherman Titov's orbiting achievement. His smile broadened as I added that I had expected the Soviets to follow up Yuri Gagarin's exploit by sending a woman, not another man, into orbit.

The Russian scientist shook his head: "I doubt if women, even our sturdy Russian women, would be sent into outer space in the near future. Women, no matter how strong, just cannot stand the difficult tests we give to our would-be cosmonauts. No matter how tough or husky they appear to be, they just wouldn't do. True, some Russian women may have been among our many volunteers. But if so, they didn't pass. Even the vast majority of men volunteers can't pass.

"You know, a tremendous number of Russian men volunteered in 1957-60, and a perfectly enormous process of weeding-out took place before Gagarin, Titov, and a few others were chosen. No woman can endure the superhuman tests they passed. You would be amazed to learn what wonderfully strong men have failed those tests."

A Russian-American traveling in Italy

this summer met two Soviet engineers who grew quite frank with him as, in their combined ignorance of Italian, they pooled their linguistic resources—first to buy trinkets, later to order food. The wine accompanying the spaghetti loosened the two Soviet tongues to a point where one of the Muscovite engineers suddenly asked the Russian New Yorker:

"Tell me honestly, candidly, was our *Sputnik* in October, 1957, actually the first artificial satellite to circle the earth? Weren't you Americans ahead of us with a *Sputnik* of your own, and most successfully?"

It took the Russian-American some minutes to realize that the questioner was not joking, and then it took some more time to convince the Soviet pair that their *Sputnik* was in fact first. The Russian engineer who had asked the question was delighted to hear the answer.

"Thank you, thank you so much," he exclaimed. "You see, we in Russia don't believe anything our government tells us. They lie to us all the time. It's a veritable plague. . . ."

—reviews—

TABLES OF BLACKBODY RADIATION FUNCTIONS, M. Pivovonsky and M. Nagel; The Macmillan Co. 481 pp., $12.50.

Presented is a tabulation of Planck's radiation law and a number of related functions describing the radiant and luminous properties of ideal thermal radiators.

The tables cover a broad range of wavelengths and temperatures, saving the researcher time-consuming interpolations and other calculations. Conversion data have been included to prevent obsolescence in case of changes of the atomic constants on which the tables are based.

HANDBOOK OF ASTRONAUTICAL ENGINEERING, Heinz Herman Koelle, Editor. McGraw Hill, 1814 pp., $27.50.

This is the first summary of the present state of the art of space flight technology.

Prepared by a team of 150 specialists from government agencies, industry, and universities, the Handbook is the culmination of three year's work in screening books, articles and reports.

Some of the special topics covered include: space flight applications and implications, economy of space flight, program management and systems engineering, free-flight trajectories close to celestial bodies, space communication, advanced propulsion systems, and ground and space operations.

STATEMENT REQUIRED BY THE ACT OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, JULY 2, 1946 AND JUNE 11, 1960 (74 STAT. 208) SHOWING THE OWNERSHIP, MANAGEMENT, AND CIRCULATION OF

MISSILES AND ROCKETS, published every Monday with the exception of the last Monday in December at Washington, D.C., for October 2, 1961.

1. The names and addresses of the publisher, editor, managing editor and business manager are: Publisher, Edward D. Muhlfeld, Washington, D.C.; Editor, William J. Coughlin, Washington, D.C.; Managing Editor, William E. Howard, Washington, D.C.; Business Manager, Leonard A. Eiserer, Washington, D.C.

2. The owner is: American Aviation Publications Inc., 1001 Vermont Ave., N.W., Washington 5, D.C. Stockholders owning 1% or more of total amount of stock: Wayne W. Parrish, Washington, D.C.; Leonard A. Eiserer, Washington, D.C.; Eric Bramley, Washington, D.C.; Jay Shuler, Springville, N.Y.; Robert R. Parrish, Chicago, Ill.; E. J. Stackpole, Harrisburg, Pa.; Fred S. Hunter, Washington, D.C.; A. H. Stackpole, Harrisburg, Pa.

3. The known bondholders, mortgagees, and other security holders owning or holding 1% or more of total amount of bonds, mortgages, or other securities are: None.

4. Paragraphs 2 and 3 include in cases where the stockholders or security holder appears upon the books of the company as trustees or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees hold stock and securities in a capacity other than that of a bona fide owner.

5. The average number of copies of each issue of this publication sold or distributed through the mails or otherwise to paid subscribers during the 12 months preceding the date shown above was: 31,631.

EDWARD D. MUHLFELD
(Signature of publisher)

Sworn to and subscribed before me this 18th day of September 1961.

RETTA B. LUDDEKE
Notary Public.
(My commission expires Nov. 14, 1962)

names in the news

MAY

BACON

CHASE

BARNES

BARR

Howard W. McFarland: With Marquardt Corp., Van Nuys, Calif., for more than ten years, appointed manager of Aerospace Propulsion Project Dept.

Herbert A. May, Jr.: Appointed assistant to **George M. Bunker,** Martin Co. board chairman; **Roland (Bud) Carlson** named to replace May as assistant to Martin president **William B. Bergen.**

William C. Ruch: Named director of development research; **Dr. Robert W. Mason,** director of laboratory research; and **Charles D. Boyer, Jr.,** director of planning research, Allied Chemical's General Chemical Division, Research Laboratory, Morris Township, N.J.

Capt. Noel R. Bacon, USN (ret.): Joins American Machine & Foundry Co.'s Government Products Group as manager of program controls. Prior to joining AMF, Capt. Bacon was Commanding Officer of the U.S. Naval Photographic Center.

Patrick S. Chase: Elected president, Servonic Instruments, Inc., Costa Mesa, Calif., succeeding the late **James A. DeJulio,** founder of the firm.

Sanford B. Kaynor: Promoted to secretary of U.S. Industries, Inc., New York City.

D. E. Egan: Formerly with Kaiser Fleetwings, Inc., appointed assistant to the president of Rocketdyne, a division of North American Aviation, Inc., Canoga Park, Calif.

Roy L. Ash: Former executive vice president, elected president, Litton Industries, Inc., Beverly Hills, Calif., succeeding **Charles B. Thornton,** now chairman and chief executive officer.

Frank C. Kerr: Named marketing manager of newly formed Electro-Mechanism Div., Omega Precision, Inc., Azusa, Calif. Prior to joining Omega, Kerr was marketing manager for the former Missile Products Div., Beckman & Whitley, Inc.

Col. Albert J. Wetzel: Appointed Assistant to the Commander, Ballistic Systems Division, Air Force Systems Command, Los Angeles. As assistant to **Maj. Gen. T. P. Gerrity,** Commander, BSD, Col. Wetzel brings to this position years of experience in the field of guided missiles. Because of his long service as director of the *Titan* guided missile program, he is generally known as "Mr. Titan."

John C. Barnes: Named vice president, Hycon Mfg. Co., Monrovia, Calif., Barnes formerly was assistant to the chief scientist and acting director of the laboratories at North American Aviation's Space and Information Systems Division.

James L. Kimball: Project engineer for Cohu Electronics, Inc., Kin Tel Div., San Diego, promoted to assistant chief engineer. He will coordinate all engineering activities for Kin Tel.

Donald Ramaker: Development engineer, Hamilton Standard, div. of United Aircraft Corp., Windsor Locks, Conn., promoted to chief of design of the engineering dept.

Clarence H. Lewis: Appointed manager, Westinghouse's Astroelectronics Laboratory, Conejo Valley, Calif. Lewis replaces **J. E. Darr,** who is returning to the Air Arm Engineering Dept., Baltimore.

Donald Friedman: Former engineering manager and military operations manager, ACF's Electronics Div., appointed head of Land Operations Dept., General Motors Defense Systems Div.

Dr. Norman Lee Barr: Named head of Biological Sciences and Systems Dept., General Motors Defense Systems Div., Warren, Mich. Dr. Barr formerly was Director of Aviation Medicine and Submarine Medicine Research and Deputy Director for Medical Research. He also served on the committee that established environmental control criteria for project *Mercury*, selected the *Mercury* astronauts and developed their training program.

J. J. Rendos: Appointed assistant manager, Cryogenic Engineering Dept., Air Reduction Sales Co., New York City.

George R. Spitzer: Appointed assistant to the president, Missile Systems Corp., Beverly Hills, Calif. Formerly Spitzer was chief of support publications, Astronautics Div., General Dynamics Corp.

Richard C. Koperek: With the Hallamore Div., The Siegler Corp., Anaheim, Calif., since 1955, promoted to vice president and treasurer of Hallamore Div. and continues to serve as assistant secretary of The Siegler Corp.

Charles E. Ducommun: Los Angeles industrialist and civic leader, elected to the board of directors, Lockheed Aircraft Corp. Ducommun is president of Ducommun Metals & Supply Co., a director of Security-First National Bank of Los Angeles, and Pacific Telephone and Telegraph Co.

Jack G. Anderson: Formerly with General Dynamics/Electronics, joins Kollsman Instrument Corp., major division of Standard Kollsman Industries, as vice president of marketing.

Dr. J. Gordon Wells: Named assistant director of the life sciences department, North American Aviation's Space and Information Systems division, Downey, Calif. Dr. Wells formerly was with the Air Force School of Aviation Medicine, and supervisor of Northrop Corp.'s human engineering organization.

Charles J. Ellis and **Harry P. Gough:** Elected regional vice presidents, General Electric Co., for the Southeastern and Western regions, respectively.

I. Nevin Palley: Elected executive vice president, Curtiss-Wright Corp., Wood-Ridge, N.J. Palley joins Curtiss-Wright from ITT-Federal Laboratories, of which he was president.

William A. Wildhack: Former special assistant to the director, appointed associate director, National Bureau of Standards, Washington, D.C. He will be responsible for coordination of NBS measurement services to science, industry, other agencies of the Federal government, and the states.

John R. Herring: Former director of the program office, promoted to manager, Engineering and Production, West Coast Testing Div., Wyle Laboratories, El Segundo, Calif.

contracts

NASA

$3,996,129—**Electronic & Missile Facilities, Inc.**, New York City, for construction of Marshall SFC's central laboratory and office facility, Huntsville, Ala.

$1,140,426—**Chrysler Corp.**, Detroit, for engineering, design and construction of rocket components and facilities.

$1,000,000—**Radiation Incorporated**, Melbourne, Fla., from **Grumman Aircraft Engineering Corp.**, for pulse code modulation (PCM) telemetry and special data handling equipment for *Orbiting Astronomical Observatory (OAO)* satellite.

$993,559—**Radio Corp. of America**, New York City, for development of a payload capsule for testing electric-propulsion engines.

$846,000—**Flexonics Corp.**, Maywood, Ill., for design and fabrication of components in the *Saturn* pressurization and propellant feed-line system.

$177,000—**Space Technology Laboratories, Inc.**, from Marshall SFC, for development of information on cost, assembly techniques and stability control of *Saturn* and *Nova* class space vehicles (three contracts).

$95,948—**Hughes Aircraft Co.**, Culver City, Calif., for feasibility study of low-temperature thermionic energy converter for Lewis Research Center.

MISCELLANEOUS

$17,000,000—**The Martin Co.**, Orlando, Fla., from Air Force and Navy, for production of *Bullpup* air-to-surface missiles.

$1,690,392—**Sperry-Rand Corp.**, Great Neck, N.Y., for production of attitude director instruments plus spare parts, aerospace ground equipment and technical data.

$400,000—**Tele-Dynamics Div., American Bosch Arma Corp.**, Philadelphia, from **Sandia Corp.** and **Vought Electronics**, for production of miniature telemetry components.

$300,000—**Institute for Scientific Information**, Philadelphia, from **National Institutes of Health and National Science Foundation**, for study of the practicability of citation indexes and for testing their techniques of preparation.

Avien, Inc., Woodside, N.Y., from **Astro-Electronics Div. of RCA**, for modification to widen the frequency band of a multiband tracking, telemetry and command antenna for *Tiros IV*. No amount disclosed.

Vitro Engineering Co., New York City, from AEC and NASA, for design and engineering for nuclear rocket engine maintenance and disassembly building, the first component of the National Nuclear Rocket Development Center, expected to be located at AEC's Jackass Flats, Nev., test site. No amount disclosed.

NAVY

$42,400,000—**Raytheon Co.**, Lexington, Mass., for production of *Sparrow III* missiles.

$17,405,000—**Lockheed Aircraft Corp.**, Sunnyvale, Calif., for production of *Polaris* missiles.

$14,500,000—**Sparton Electronics Div. of Sparton Corp.**, Jackson, Mich., for various types of sonobuoys.

$12,000,000—**Sperry Gyroscope Co.**, Great Neck, N.Y., for navigation subsystem equipment.

$6,300,000—**Motorola, Inc.**, Chicago, for production of sonobuoys.

$2,100,000—**Thompson Ramo Wooldridge's Ramo Wooldridge Div.**, Canoga Park, Calif., from **Johns Hopkins Univ. Applied Physics Laboratory**, for shipborne computers and data-processing equipment used in conjunction with the *Transit* program to facilitate position determination from satellite-transmitted information.

$1,044,765—**Lockley Machine Co.**, New Castle, Pa., for production of *Zuni* rocket launchers.

$732,359—**General Dynamics/Astronautics**, Pomona, Calif., for facilities to meet production schedules for BT-3A and HT-3 *Terrier* and the improved *Tartar* missile programs.

$200,000—**Arthur D. Little, Inc.**, Cambridge, Mass., from ONR, for research on infrared emittance of clouds.

Westinghouse Electric Corp.'s Electronics Div., Baltimore, from **Johns Hopkins Univ. Applied Physics Laboratory**, for initial portion of development of the shipboard receiver set for the *Transit* satellite navigation system. No amount disclosed.

ARMY

$4,225,627—**Armament Div., Universal Match Corp.**, St. Louis, from ABMA, for transporter-erector-launchers (TEL) for *Pershing* missile (two contracts).

$1,400,000—**Bendix Systems Div.**, Ann Arbor, Mich., for modification of *Advent* satellite communication system.

$1,011,788—**Raytheon Co.**, Waltham, Mass., for concurrent repair parts for *Hawk* missile systems.

$242,000—**Electro-Mechanical Div., Lear, Incorporated**, Grand Rapids, Mich., from **Sperry-Utah**, for guidance-fin actuators on *Sergeant* missile.

Atomics International Div., North American Aviation, Inc., Canoga Park, Calif., for R&D study for a "back-pack"-size power supply to generate electricity directly and operate on conventional fuels. No amount disclosed.

AIR FORCE

$2,100,000—**Western Electric Co.**, New York City, for work in connection with microwave communications at classified locations.

$2,000,000—**Ampex Corp.**, Redwood City, Calif., from **Electro-Mechanical Research, Inc.**, for magnetic memory systems for *Dyna-Soar* space glider project.

$950,000—**Technical Operations, Inc.**, Burlington, Mass., for continued development and application of operations research and computer techniques for the study of aerial warfare on both global and tactical scales (Project *OMEGA*).

$600,000—**Weber Aircraft Corp.**, Burbank, Calif., from **The Boeing Co.**, for ejection seat and survival system for *Dyna-Soar* manned space glider.

$307,324—**Avco-Everett Research Laboratory**, Everett, Mass., from ASD, Wright-Patterson AFB, for study of a method to control, maneuver and land a satellite in a predetermined area by varying the vehicle's aerodynamic shape in flight.

$210,000—**Wyle Laboratories**, from ASD, Wright-Patterson AFB, for evaluation of telemetry transducers.

$100,000—**Rocketdyne Div., North American Aviation, Inc.**, for in-service engineering in support of *Atlas* weapon systems.

$95,000—**General Electric's Missile and Space Vehicle Dept.**, Philadelphia, for initial provision of airborne and AGE spares for *Titan II*, Mark VI re-entry vehicle subsystem.

North American Aviation's Space and Information Systems Div., Downey, Calif., for a study of applying the sandwich structural design concept to a solid-fuel rocket motor case or booster. No amount disclosed.

The Siegler Corp., Los Angeles, for development of major one-piece tank domes for the *Titan II* ICBM. No amount disclosed.

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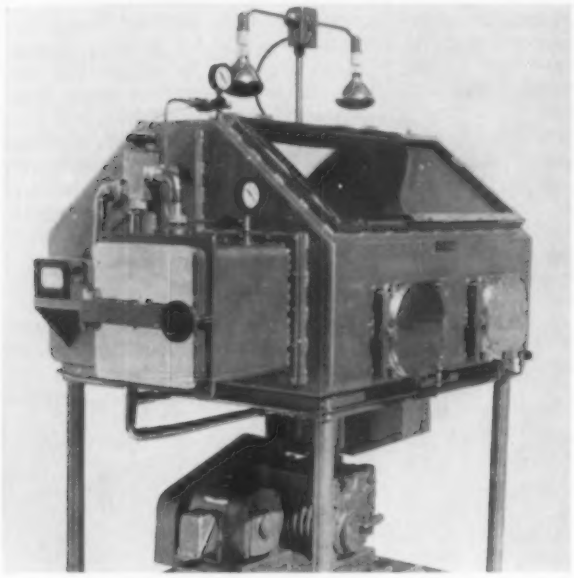

New Product of the Week: Royal's Inert-gas Box

A NEW INERT-GAS enclosure, believed suitable for explosives research and development, is now available from Royal-Research Corporation, Hayward, Calif.

Called the ERINGARD Model MkII, the unit is also designed for welding rare metals—such as molybdenum, tantalum, columbium and zirconium—which oxidize readily in the presence of normal air. Royal says selective inert gases can be used with this system.

A leak rate of less than 1 micron/minute, at a base pressure of 1 micron, assures maximum purity of the working atmosphere, the company says.

Employing heavy steel-welded construction, the new unit is equipped with four 8-inch diam. glove ports that permit two operators to work simultaneously, either as a team or independently.

Other features include a 5-cfm mechanical pump, which produces an ultimate base pressure of 1 micron, a gas-tight interchange vestibule and an exterior mounted flood light. (Models are also available with a 15-cfm pump which will bring the pressure level to 1 micron in 20 minutes.)

The vestibule is equipped with hermetically sealed pump-outs, vacuum gauges and gas inlets, making it possible to move into and out of the box or main chamber without having to evacuate the latter.

A removable feed-through plate is provided at one end of the box for electrical, gas and water connections to the inside for use with a heliarc or similar type torch. Operating area temperature is kept at an acceptable level by a ⅓-hp refrigeration system.

An important work feature of the unit, says Royal, is the increased productivity achieved through the visual access and arrangement of controls. Further, the interchange vestibule can be evacuated independently of the main chamber, making possible a reduction in inert-gas consumption and considerable savings in operating costs.

The unit measures 48 in. wide x 78 in. long x 64 in. high. The enclosure is 40 x 40 in. square and has a maximum working headroom of 26 in. Viewing windows are 16 x 37 in. Height to center of glove port is 42 in., while interchange vestibules are 12 in. by 13 in. deep.

In addition to the explosive and rare-metal-welding applications mentioned above, it also is expected to find wide use in such diverse fields as chemical production and pharmaceutical research and production.

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Solid-State Limit Switch

A limit switch featuring solid-state electronics and high reliability has been introduced by the Apparatus Division of Texas Instruments, Inc. A life test that commenced several months ago is continuing, with the switch nearing 40,000,000 trouble-free cycles. The Statronic Limit Switch has no make-or-break electrical contacts and may be used in any application where roller-lever-actuated switches are now employed. The high reliability makes it particularly useful for position indicating and limiting, safety interlocks and similar applications.

Circle No. 226 on Subscriber Service Card

Voice Band Modem

Collins Radio Co. has available a C-8102 FSK voice band modem, a multiplexing system that provides up to 18 data channels from a single 3 kc voice channel. Maximum transmission rate is 75 bits per second, equivalent to 100 words a minute in teletype operations, on each channel. The C-8102 modem communicates binary data for teletype, telemetering, remote control, telephone signalling and other applications. The system can operate unattended, since no operating controls are necessary. All or any of the 18 data channels can be supplied.

Circle No. 227 on Subscriber Service Card

Two-channel Direct Writer

The Sanborn Co. is producing Model 296, a compact two-channel direct writing oscillograph which can record an extremely wide variety of d-c to 125 cps variables, using a pair of plug-in preamplifiers.

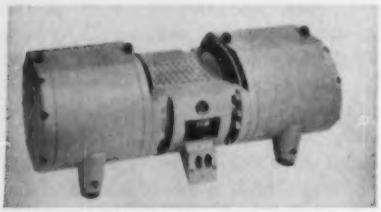
The system accepts any of the "350" series interchangeable preamplifiers: Carrier; d-c coupling for 1.0 mv/div or 5.0 mv/div recording; Phase Sensitive Demodulator; differential d-c; logarithmic; frequency deviation; and low level, with plug-in elements for general purpose d-c recording with or without zero suppression, or for excitation and detection of d-c strain gage bridges.

The preamp signals feed a dual-channel driver amplifier/power supply which drives a pair of rugged, velocity feedback-damped galvanometers. Immediate readout recording is produced by heated stylii on Sanborn rectangular-coordinate permapaper charts with 50-mm channels.

Circle No. 228 on Subscriber Service Card

Vibration-Shock Tester

The Industrial Products Division of International Telephone and Telegraph Corp. is marketing a combination vi-



bration- and shock-testing instrument, designated the ST300, which features a 250-force-pound air-bearing exciter for testing large components and subassemblies.

The instrument enables shock-testing to over 5000 g and vibration testing over a useful frequency range from 5 to 30,000 cycles. The first major resonance is above 6000 cycles.

The vibration exciter employs air bearings to support the moving element. This avoids problems inherent in the use of springs and flexures and thus makes possible an unusually flat response over a wide range of frequencies, permitting precise testing without the complications of compensating devices. Testing time and costs can be substantially reduced when shock and vibration are tested on the same instrument.

Circle No. 229 on Subscriber Service Card

X-Band Turnstile Switch

The Motorola Solid State Electronics Department is marketing Model XS04 X-band turnstile switch. Based on the turnstile circulator, the switch consists of two crossed rectangular waveguides with a 45° Faraday rotator in a shorted circular waveguide section which is orthogonal to the broad wall of the rectangular guides.

A signal at port no. 1 is transmitted to port no. 2 with ports 3 and 4 decoupled; a signal at port no. 2 is coupled to port no. 3, etc. To obtain the switching function, the direction of circulation is reversed by reversing the magnetic field applied to the Faraday rotator.

Circle No. 230 on Subscriber Service Card

Flat Conductor Cable Connector

The National Connector Corp. has in production a flat conductor cable connector designed so that it may be used without soldering or splicing individual wires in flat conductor cable. The connector is relatively uncomplicated in construction and possesses many features not found in other flat conductor cable connectors now on the market. Designed for high reliability and positive locking characteristics under conditions of stress, the connector was designed for applications in data processing and readout systems. A quick connect-disconnect type, the connector consists of two high impact plastic mating halves which are attached to stripped ends of the tape by welding, soldering, crimping or mechanical pressure. The contacts may be removed from the connector for assembly to the conductor of the flat conductor table.

Circle No. 231 on Subscriber Service Card

D-C Countermeasure Blocks

Two d-c blocks, covering a frequency range of 1 through 7 kmc, have just been developed by the Weinschel Engineering Co. These blocks, Models 875 and 876, are particularly designed for use on countermeasures systems where components are permanently installed. The Model 875 has a frequency range of 1 through 2 kmc with a maximum insertion loss of 0.3 db. The maximum vswr is 1.25. The Model 876 has a frequency range of 2 through 7 kmc with a maximum insertion loss of 0.4 db. Its maximum vswr is 1.30.

Circle No. 232 on Subscriber Service Card

Multi-Tube Furnace

Lindberg Engineering Co. is marketing a four-tube diffusion furnace with a detachable automatic pusher mechanism. The furnace reaches a maximum temperature of 1300°C in its 30 in.-long heating chamber, and has a rated uniformity of 18 in. ±1.0°C.

It is operated by two zones of control. Each zone has 12 globars, a 9.0 kva tapped-element transformer, a platinum-13% rhodium controlling thermocouple, and a Wheelco proportioning controller to indicate and control the temperature in each zone. Dimensions of the furnace and base only are 37 in. wide, 75 in. high and 52 in. long. Addition of the pusher mechanism increases the length to 91 in

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S, C and X-Band Measurements

Accurate measurement of frequencies in the S, C and X-Bands is readily obtainable with a panel-mounted unit, incorporating a series of tunable band-

pass filters, available from Frequency Standards. Insertion loss of the tunable filter in each of the bands (including a low-pass filter, bandpass-filter adapters and interconnecting line) is less than 4 db average. Absolute accuracy of the calibrated frequency is ±0.01%. Bandwidth at 11 and 9 mcs is 3 db down and 0.25 db down, respectively. Spurious reponses are eliminated by a low-pass filter, and tuning is achieved by a single duo-dial counter.

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Fiber-Optic Cathode Tube

Faceplates using developments in fiber optics combine with high-resolution electron guns to significantly increase the resolution and brightness of new cathode ray tubes produced by Electronic Tube Corp.

In place of the usual glass faceplates, the tubes have insulated bundles of tiny glass fibers that eliminate the halation caused by excitation of neighboring phosphors, prevent refraction, and improve light transmission as much as 80 times over standard CR tubes. This, in combination with special high-resolution electron guns, makes it possible to reduce spot size to a dimension that greatly increases the usefulness of CR tubes for data display, radar, mapping and other exacting applications.

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7th National Communications Symposium, IRE Professional Group on Communications Systems, Utica, N. Y., Oct. 2-4.

IRE Canadian Electronics Conference, Automotive Bldg., Exhibition Park, Toronto, Oct. 2-4.

XII International Astronautical Congress, hosted by American Rocket Society, Washington, D. C., Oct. 2-7.

8th Annual Science & Engineering Symposium, AFSC and Aerospace Research, Sheraton-Palace Hotel, San Francisco, Oct. 3-4.

9th Annual Human Engineering Institute, Stamford, Conn., Oct. 3-6.

American Society of Photogrammetry Semi-annual Convention, Biltmore Hotel, New York City, Oct. 4-6.

17th National Electronics Conference and Exhibition, International Amphitheatre, Chicago, Oct. 9-11.

National Aeronautic and Space Engineering and Manufacturing Meeting, sponsored by Society of Automotive Engineers, Hotel Ambassador, Los Angeles, Oct. 9-12.

Space Flight Report to the Nation, American Rocket Society, New York Coliseum, New York City, Oct. 9-15.

Symposium on Shock, Vibration and Associated Environments, sponsored by DOD, Office of Director of R&E, Detroit, Oct. 10-12.

Optical Society of America Meeting, Somerset Hotel, Boston, Oct. 12-14.

17th Annual ISA Instrument-Automation Conference and Exhibit, New York Coliseum, New York City, Oct. 15-19.

Second International Congress, International Organization for Vacuum Science and Technology, Eighth Annual Symposium of the American Vacuum Society, Washington, D. C., Oct. 16-19.

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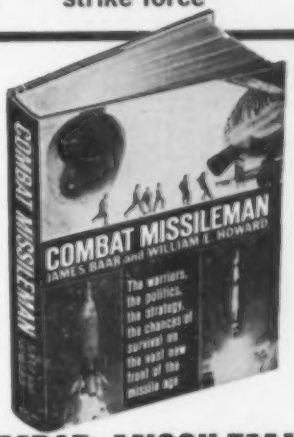
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editorial . . .

Fall Forecast: Faster and Warmer

IT IS WITH considerable relief that we note the Administration finally is stepping up its planning for both military and civilian space programs. The pace this year has been entirely too slow.

But there is a fall quickening all along the line.

The National Aeronautics and Space Administration is moving to get its big *Apollo* program under way. The NASA reorganization which is reported in this issue is designed to streamline the agency for management of the civilian man-in-space effort. The shuffle brings RCA's D. Brainerd Holmes into the NASA organization as the man who will, in effect, be the Czar of the *Apollo* project. We are pleased at the initial indications that NASA intends to give him the authority to get on with the job. The management setup is a compromise over the special projects office recommended by many in industry. But it is not the organization chart that counts as much as how it works.

It appears that Mr. Holmes may have "special project" authority even if his directorate does not bear that title. That's the important thing, together with the director's willingness to delegate authority where this is necessary. One of the things that made the *Polaris* special project approach work well was the willingness of the man at the top to let his subordinates make many of the important decisions. And Heaven help them if they made the wrong one!

From talking to his colleagues at RCA, we gather that Mr. Holmes may be just such a leader. We are pleased to report that he is highly thought of by those who worked with and for him.

It is significant that Mr. Holmes comes from RCA. He is one of the management men who have grown with the missile/space industry, rather than with its earlier parent, the aircraft industry. He may, as a result, be in a better position to deal with the complex management problems of the lunar program. You will find on page 17 a list of the top 25 NASA contractors in Fiscal '61. It is interesting to note that of these, only seven can even remotely be identified as aircraft firms. It is a measure of the growth which has taken place in a very few years.

Concurrently with the reorganization of NASA comes a stepped-up recruiting drive which will see the agency grow to well over 21,000 employees in the near future. This growth undoubtedly is necessary as NASA responsibilities are enlarged and as the lunar program develops. It is a growth which should be kept carefully in hand, however. The temptation to empire-build is a strong one.

We are concerned over some early indications that NASA is being tempted at the thought of in-house, as contrasted with industry, management of phases of the *Apollo* program. We refer you to the Letters column for further thoughts on this line. We hope Mr. Holmes will make an early review of the decision on *Apollo* guidance one of the first items on his NASA calendar.

With the increasing pace of activity at NASA comes an indication that the National Aeronautics and Space Council headed by Vice President Johnson may be taking a more active role in direction of the nation's space affairs. Little has been heard of the organization since President Kennedy's decision to give it an active role in the policy-making of the Administration.

But it develops that the NASC has played a quiet part in a number of space decisions in recent months. As cited by its executive secretary, Dr. Edward Welsh, these include:

—The decisions to activate the big booster programs and the *Apollo* lunar program.

—Drafting of the new Air Force program for large solid boosters.

—Approval for inclusion of the nuclear auxiliary power unit in a space probe.

—The communication satellite decision which puts a commercial system in the hands of the international common carriers.

—Approval of plans for the Project *West Ford* communications experiment involving a net of needle-like particles in earth orbit.

IT IS REASSURING to know that an agency directly responsible to the President is taking part in decisions concerning space which cut across the duties of a number of other government bodies—from Air Force to FCC to NASA to the Weather Bureau.

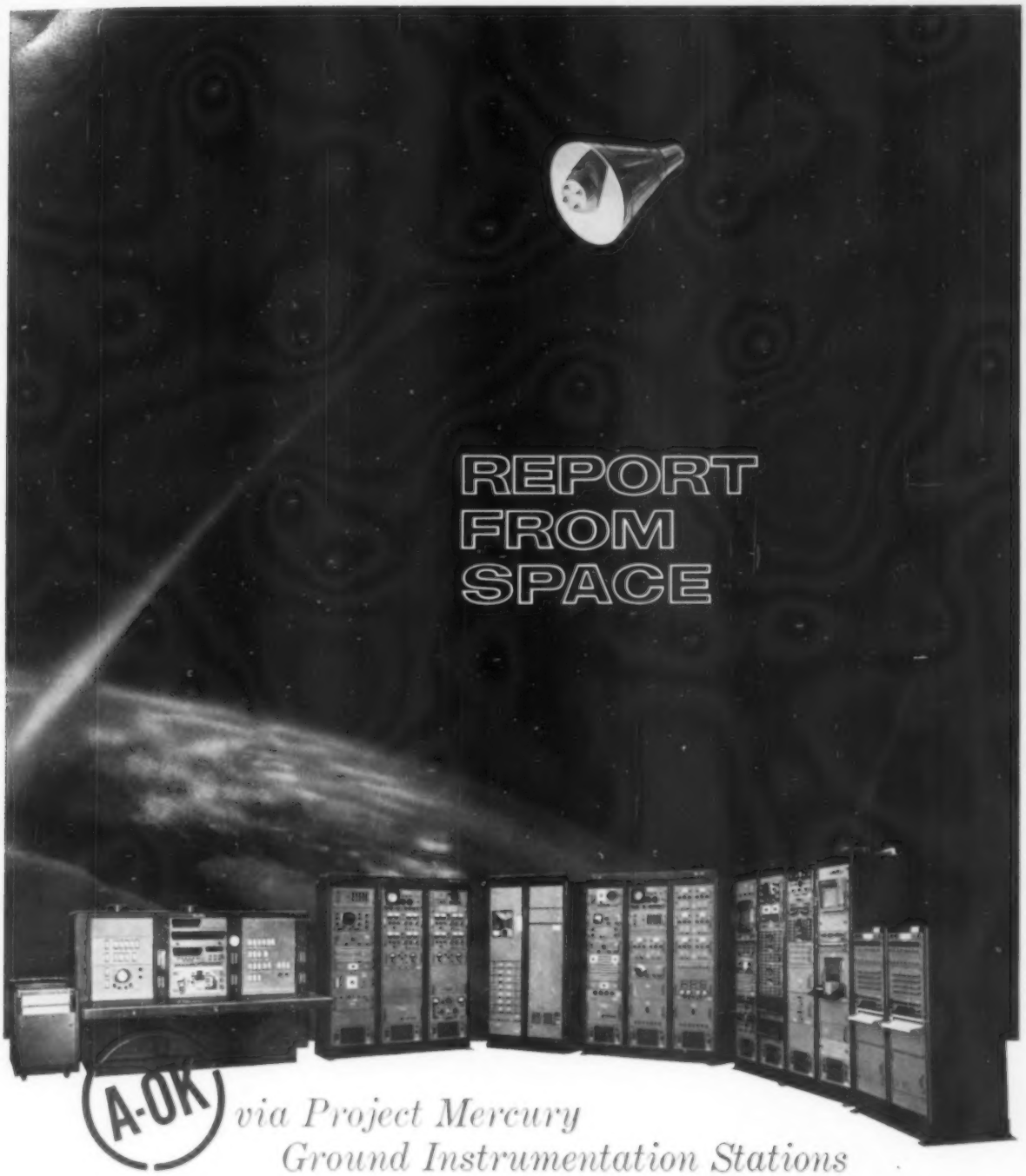
The stepped-up Air Force drive for a bigger role in the space program also is a welcome end-of-year development. This is an absolute must, as this magazine has insisted for several years. The reasons were clearly spelled out in the symposium at the Air Force Association's Philadelphia meeting. We must be prepared to meet any Russian military threat in space. For very sound arguments on this subject, we refer you to the remarks on p. 12.

As expressed in Philadelphia, the idea of simply hoping for military fallout from a civilian space program seems a clear case of cart-before-the-horse in the light of Soviet activities. There must be a clear effort to assure military benefits.

It is heartening to know that talks now are under way to improve coordination at the "interface" between NASA and the Air Force.

All in all, the fall prospects are more encouraging than the picture during a lethargic summer and spring. We look ahead to a busy winter for the industry.

William J. Coughlin



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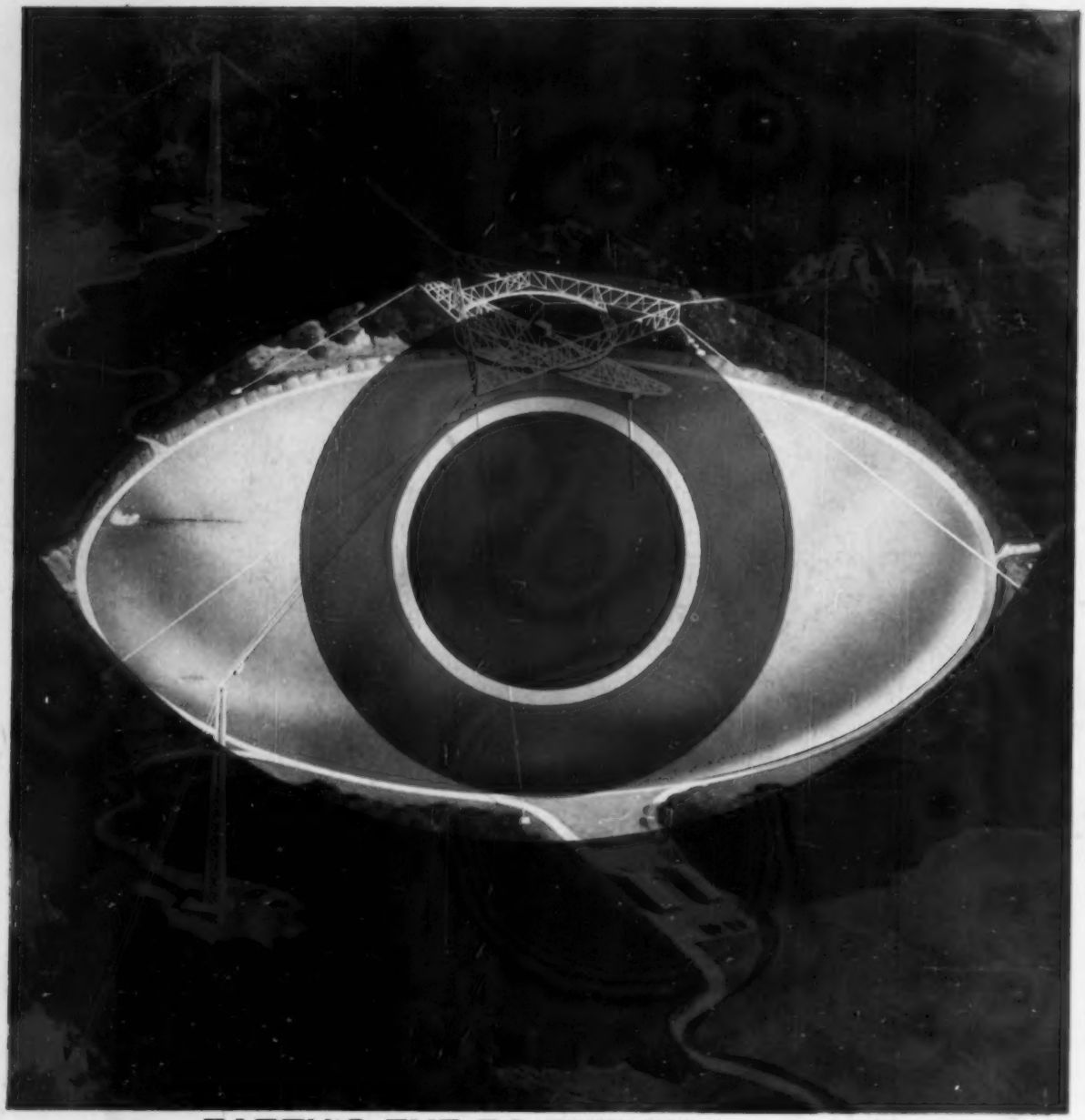

EARTH'S EYE TO THE SKY

Men have searched the sky for knowledge since history began. Each generation sees farther, learns more. But the human eye is reaching its limit — and there is still much more to know.

Radar astronomy can help. In Puerto Rico, the world's largest radar will send beams from an unusually powerful transmitter into a 1,000-foot wire mesh reflector, to bounce back out into space. The returning signals will extend man's "vision" by millions of miles.

Two Varian VA-842 klystrons will power the transmitter for this advanced USAF project. With each 2,000-microsecond pulse, these super-power tubes deliver 2.5 million watts at 430 megacycles. Write Tube Division for technical information.

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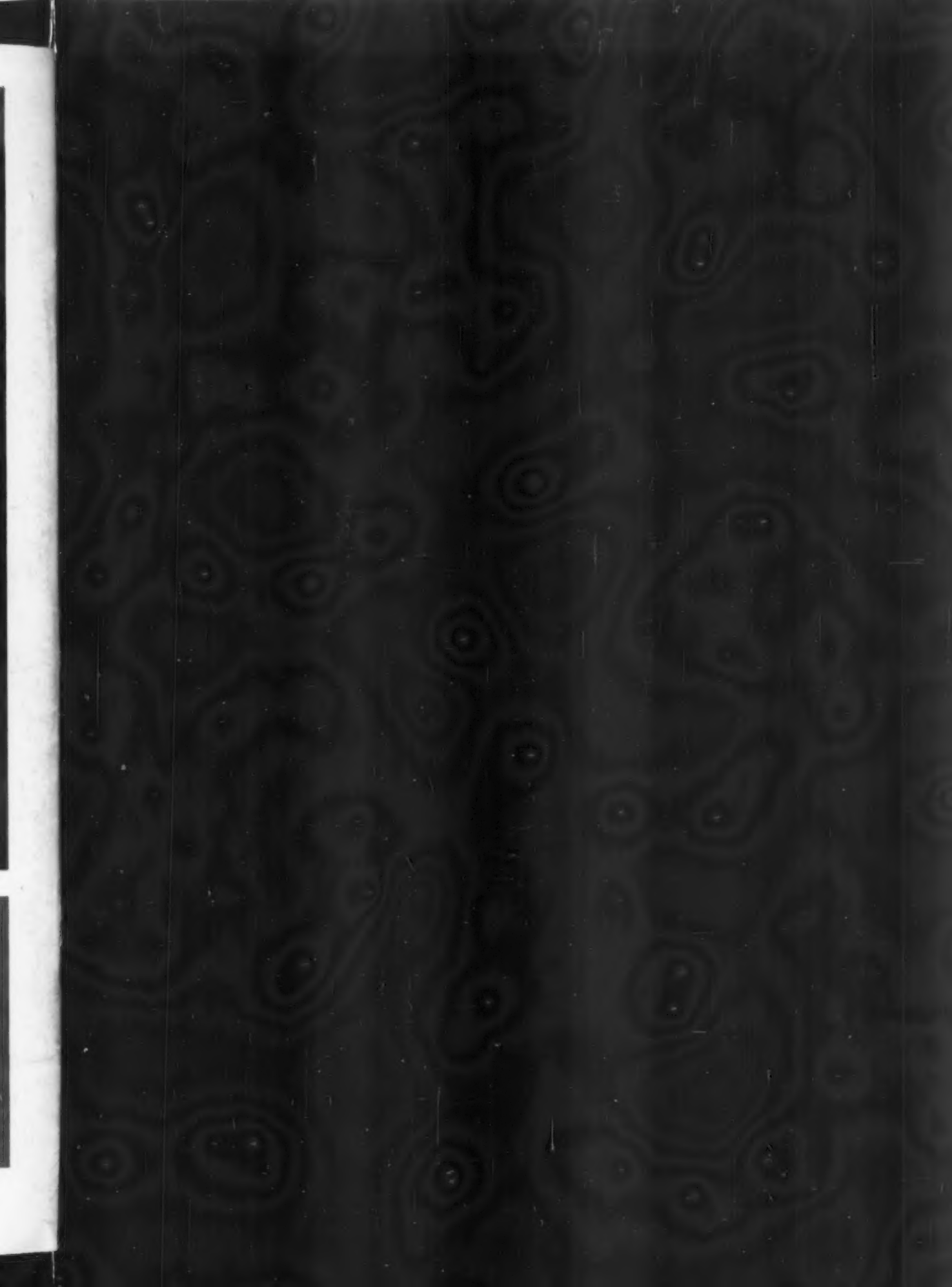
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